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The Society of the
Plastics Industry, Inc.

SPI

1981 edition

Facts & Figures of the Plastics Industry

First Printing: September 1981

FACTS & FIGURES is prepared annually by H. Kibbel of the Statistical Department under the supervision of A. J. Evans, Director. All inquiries regarding its content should be addressed to that department at The Society of the Plastics Industry, Inc., 355 Lexington Avenue, New York, N.Y. 10017.

Price: $45.00 (SPI members); $90.00 (non-members)

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.

The Society of the Plastics Industry, Inc. is a member-run federation dedicated to promoting and protecting continuing growth for the plastics industry in the United States. The Society represents more than 1,400 members responsible for over 95 percent of plastics materials production and 75 percent of U.S. plastics product sales.

SPI's 70 operating units and more than 300 committees have membership drawn from all segments of the industry—processors, resin and adjuvant suppliers, plastics distributors, machinery builders, and moldmakers. The Society serves as a federation of semi-autonomous, interrelated groups with a strong, common interest in the overall health of the plastics industry.

SPI serves as the "industry spokesman." It identifies and provides positive responses to misinformation and to potentially harmful regulations, bills, or court decisions by mobilizing pertinent facts and carrying out programs for timely and forceful action. At the same time, SPI works to prevent such damaging situations from occurring by building a positive understanding of the industry. The Society's service committees provide liaison with government agencies, code and regulatory groups, and many other associations.

SPI sponsors research projects in areas such as energy use, resource recovery, combustibility, and worker safety, at major private research organizations. The Society conducts numerous information programs, providing literature, surveys, reports, newsletters, and handbooks for industry and public use.

SPI sponsors one of the largest trade shows in the United States—the National Plastics Exposition, held every three years. The last show, held in June 1979, drew 43,000 visitors who viewed the products and services of more than 500 exhibitors. The next NPE, scheduled for June 21-25, 1982 in McCormick Place, Chicago, IL, promises to be even bigger.

Incorporated in 1937, SPI has grown with the dynamic industry it represents. In addition to the Society's headquarters office in New York City, SPI has five section offices: Eastern Section, 169 Union Boulevard, Totowa, NJ 07512; New England Section, 20 Speen Street, Framingham, MA 01701; Midwestern Section, 3150 Des Plaines Avenue, Des Plaines, IL 60018; Washington, D.C. Office, 1724 H Street, N.W., Washington, D.C. 20006, and Western Section, Saddleback Square, Suite 124, 12440 Firestone Boulevard, Norwalk, CA 90650.

SPI draws together the diverse segments of the plastics industry into an effective organization that represents the entire industry.

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DEVELOPMENT OF TODAY'S PLASTICS

Today's plastics are the most used material on a volume basis in America's industrial and commercial life. The role of plastics is so broadly integrated in our own lifestyle that today there is virtually no product area where plastics do not make a major, irreplaceable contribution. Although the plastics industry in the United States is now in its second century, the most important developments have occurred since 1910. However, the roots of these modern developments go back not only to the research of cellulose nitrate by John Wesley Hyatt in the 1860's, but also to the plastic-like compositions used by man through the centuries.

ORIGIN OF PLASTICS

One can go as far back as the Old Testament to find references about natural materials used as fillers, adhesives, coatings, and the like. These materials were the precursors of what we call plastic materials today. Consequently, historians differ as to the exact date that the plastics industry began, and they will continue to do so since an exact year or even decade for the event is a matter of interpretation as to what constitutes a "plastic."

Certainly the history of the rubber industry has a bearing on plastics since ebonite, or hard rubber, discovered in 1851, was the first thermosetting material to be prepared and also the first material which involved a distinct chemical modification of a natural material. But ebonite was not exploited commercially for some years after its discovery and for that reason its historical importance has become somewhat blurred.

EUROPEAN DEVELOPMENTS

While the basic processes of rubber technology were developing, other important discoveries were taking place in Europe. Following work by Pelouze, Schönbein was able to establish conditions of controlled nitration of cellulose. The product soon became of interest as an explosive and in the manufacture of collodion, a cellulose solution in an alcohol-ether mixture. In the 1850's the English inventor Alexander Parkes observed that the solid residue left after the evaporation of the solvent of photographic collodion was a "hard, horny elastic and waterproof substance." In 1856 he patented the process of waterproofing woven fabrics by the use of such materials.

In 1862 the Great International Exhibition was held in London. It was there that Parkes introduced a new material named for himself—Parkesine. Parkesine was obtained by dissolving cellulose nitrate in a minimum of solvent. The mixture was then put on a heated rolling machine from which some of the solvent was then removed. While still in the plastic state the material was then shaped by dies or pressure. In 1866 Parkes organized the Parkesine Company to manufacture products from his new material, but the company failed in 1868. This appears in part due to Parkes' attempt to reduce production costs which resulted in the production of inferior items.

One year after the failure of the Parkesine Company, an associate of Parkes, Daniel Spill, formed the Xylonite Company to manufacture products similar to Parkesine. Once again economic failure resulted and Spill's company went bankrupt in 1874. Undaunted, Spill moved to a new site, established the Daniel Spill Company and continued production of his material, Xylonite.

FIRST PLASTICS IN THE U.S.

In the United States during the 1860's someone else was experimenting with cellulose nitrate—John Wesley Hyatt. In 1865 Hyatt became involved in devising a method for producing billiard balls from materials other than ivory. Originally using mixtures of cloth, ivory dust and shellac, in 1869 he patented the use of collodion for coating billiard balls. The patent came one year after his collodion material was introduced commercially.

John W. Hyatt and his brother Isaiah took out U.S. Patent 105,338 in 1870 for a process of producing a horn-like material using cellulose nitrate and camphor. Although Parkes and Spill had mentioned camphor in their work it was the Hyatt brothers who recognized the value of camphor as a plasticizer for cellulose nitrate. In 1872 the term celluloid was coined by Isaiah Hyatt to describe the Hyatts' commercially successful product.

The validity of Hyatts' patents was challenged by Spill and a number of court actions took place between 1877 and 1884. In the final action it was found that Spill had no claim on the Hyatt brothers, the judge ruling that the true inventor of the process was Parkes since he (Parkes) had mentioned the use of camphor in his patents. Thus, there was no restriction on the use of these processes and any company, including the Hyatts' Celluloid Manufacturing Company, were free to use them. After that decision the Celluloid Manufacturing Company prospered, changed its name to the American Celluloid Chemical Corporation, and eventually was absorbed by the Celanese Corporation.

FORMALDEHYDE RESINS

Next to cellulose nitrate the most important material in the early history of plastics was formaldehyde. Around 1897 there was a demand in German schools for a white chalkboard. Efforts to obtain such a product resulted in the discovery of casein plastics, produced by reacting casein (milk protein) with formaldehyde. The material soon became established under the trade names of Galalith and Erinoid, and today casein is still used by the button industry.

In 1899 Arthur Smith took out British Patent 16,274, the first dealing with phenol-formaldehyde resins, in this case for use as an ebonite substitute in electrical insulation. During the next decade the phenol-formaldehyde reaction was investigated mainly for academic interest. In 1907 however, Leo Hendrik Baekeland discovered techniques of so controlling and modifying the reaction that useful products could be made from it. Thus phenolics were the first fully synthetic resins to become commercially successful.

Prompted by the success of phenolic moldings, research began on reacting other materials, such as urea and thiourea, with formaldehyde. These materials were used in the manufacture of molding powders. Unlike the phenolics, they could be molded into light-colored articles and they rapidly achieved commercial success. Today these urea-based resins are used for molding powders, adhesives, and textile and paper finishing while the related melamine-formaldehyde resins are used in decorative laminates.

GROWTH OF MODERN PLASTICS

Cellulose acetate, a thermoplastic, was developed about the same time as the urea-based resins. Similar in structure to cellulose nitrate, it was found to be safer in processing and use. Cellulose acetate was introduced as a molding compound in 1927.

The period 1930-1940 saw the initial commercial development of today's major thermoplastics; polyvinyl chloride; low density polyethylene; polystyrene; and polymethyl methacrylate. The advent of the Second World War in 1939 brought plastics into great demand, largely as substitutes for materials in short supply, such as natural rubber. In the United States the crash program leading to large-scale production of synthetic rubbers resulted in extensive research into the chemistry of polymer formation, and eventually, to the development of more plastic materials.

The first decade after World War II saw the development of high density polyethylene and polypropylene and the growth of the newer plastics in many applications. Large-scale production of these materials reduced their cost dramatically. The new materials began to compete with the older plastics and even with the more traditional materials such as wood, paper, metal, glass and leather. Since that time the demand for plastics has increased steadily so that plastics are now accepted by designers and engineers as basic materials along with the more traditional materials. The automotive industry, for instance, relies on plastics to reduce weight and thus increase mileage.

INTRODUCTION OF PLASTICS RESINS

DATE	MATERIAL	EXAMPLE
1868	Cellulose Nitrate	Eye Glass Frames
1909	Phenol-Formaldehyde	Telephone Handset
1919	Casein	Knitting Needles
1926	Alkyd	Electrical Bases
1927	Cellulose Acetate	Tooth Brushes
1927	Polyvinyl Chloride	Wall Covering
1929	Urea-Formaldehyde	Lighting Fixtures
1935	Ethyl Cellulose	Flashlight Cases
1936	Acrylic	Brush Backs
1936	Polyvinyl Acetate	Flash Bulb Lining
1938	Cellulose Acetate Butyrate	Packaging
1938	Polystyrene	Housewares
1939	Nylon	Gears
1939	Polyvinylidene Chloride	Packaging Film
1939	Melamine-Formaldehyde	Tableware
1942	Unsaturated Polyester	Boat Hulls
1942	Low Density Polyethylene	Packaging
1943	Fluoropolymers	Industrial Gaskets
1943	Silicone	Motor Insulation
1945	Cellulose Propionate	Pens and Pencils
1947	Epoxy	Tools and Jigs
1948	Acrylonitrile-Butadiene-Styrene (ABS)	Luggage
1954	Styrene-Acrylonitrile (SAN)	Housewares
1954	Polyurethane	Foam Cushions
1956	Acetal	Automotive Parts
1957	High Density Polyethylene	Milk Bottles
1957	Polypropylene	Safety Helmets
1957	Polycarbonate	Appliance Parts
1959	Chlorinated Polyether	Valves and Fittings
1962	Phenoxy	Bottles
1964	Ionomer	Skin Packaging
1964	Polyphenylene Oxide	Battery Cases
1964	Polyimide	Bearings
1964	Ethylene-Vinyl Acetate	Adhesives and Coatings
1965	Polysulfone	Electrical/Electronic Parts
1970	Thermoplastic Polyester	Electrical/Electronic Parts
1973	Polybutylene	Piping
1973	Polyphenylene Sulfide	Telecommunications
1974	Polyethersulfone	Printed circuit boards
1975	Nitrile Barrier Resins	Non-food Packaging
1978	Linear Low Denisty Polyethylene	Extruded Film

1980 IN REVIEW—PRODUCTION AND SALES & CAPTIVE USE*
(in millions of pounds)

Resin	Production			Sales & Captive Use		
	1980	1979	% Change	1980	1979	% Change
Epoxy	315	361	—12.7	319	332	—3.9
Phenolic	1,499	1,781	—15.8	1,517	1,732	—12.4
Polyester	947	1,147	—17.4	949	1,152	—17.6
Urea	1,165	1,367	—14.8	1,147	1,355	—15.4
Melamine	167	200	—16.5	166	192	—13.5
Total Selected Thermosets	4,093	4,856	—15.7	4,098	4,763	—14.0
ABS	920	1,191	—22.8	916	1,183	—22.6
SAN	111	124	—10.5	103	126	—18.3
HDPE	4,405	5,010	—12.1	4,394	4,893	—10.2
LDPE	7,291	7,793	—6.4	7,467	7,815	—4.5
Nylon	274	327	—16.2	271	315	—14.0
Polypropylene	3,648	3,841	—5.0	3,714	3,894	—4.6
Polystyrene	3,521	4,005	—12.1	3,518	3,997	—12.0
PVC	5,470	6,119	—10.6	5,407	6,138	—11.9
Total Selected Thermoplastics	25,640	28,410	—9.8	25,790	28,361	—9.1
Total Selected Plastics	29,733	33,266	—10.6	29,888	33,124	—9.8
All Other Plastics	7,614	8,311	—8.4	5,297	5,593	—5.3
Grand Total	37,347	41,577	—10.2	35,185	38,717	—9.1

*Excludes Polyurethane.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

1980 IN REVIEW—
DISTRIBUTION OF SALES & CAPTIVE USE BY MAJOR MARKET
(in millions of pounds)

Major Market	1980	1979	% Change	Share of Total	
				1980	1979
Transportation	1,605	1,934	—17.0	4.6%	5.0%
Packaging	10,003	10,334	—3.2	28.4	26.7
Building/Construction	6,424	7,573	—15.2	18.3	19.6
Electrical/Electronic	2,453	3,043	—19.4	7.0	7.9
Furniture/Furnishings	1,646	1,894	—13.1	4.7	4.9
Consumer/Institutional	3,553	3,753	—5.3	10.1	9.7
Industrial/Machinery	391	517	—24.4	1.0	1.2
Adhesives, Inks & Coatings	2,387	2,794	—14.6	6.8	7.2
Other	3,054	3,443	—11.3	8.7	8.9
Exports	3,670	3,432	+6.9	10.4	8.9
Total	35,186	38,717	—9.1	100.0%	100.0%

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

TOTAL U.S. PRODUCTION AND SALES & CAPTIVE USE OF PLASTICS RESIN: 1955-1980

(in millions of pounds)

YEAR	PRODUCTION (Excluding Polyurethane)	POLYURETHANE PRODUCTION[d]	PRODUCTION (Including Polyurethane)	SALES & CAPTIVE USE (Excluding Polyurethane)
[a]1955	3,750	1	3,751	3,160
1956	3,991	8	3,999	3,406
1957	4,385	17	4,402	3,740
1958	4,578	33	4,611	4,003
1959	5,925	67	5,992	5,097
1960	6,226	95	6,321	5,277
1961	6,780	150	6,930	5,905
1962	7,977	220	8,197	6,952
[b]1963	9,084	280	9,364	7,380
1964	10,230	295	10,525	8,581
1965	11,829	390	12,219	10,684
1966	13,719	480	14,199	11,294
1967	13,923	550	14,473	11,789
1968	16,581	650	17,231	14,811
1969	18,935	785	19,720	15,788
1970	19,226	830	20,056	16,747
[c]1971	20,201	960	21,161	18,949
1972	25,285	1,190	26,475	24,433
1973	27,783	1,430	29,213	27,432
1974	27,944	1,330	29,274	26,693
1975	21,588	1,240	22,828	21,162
1976	27,646	1,550	29,196	26,984
1977	32,098	1,850	33,948	31,106
1978	35,655	1,950	37,605	35,063
1979	39,477	2,100	41,577	38,717
1980	35,447	1,900	37,347	35,186

[a]U.S. Tariff Commission data used for 1955-1970. May exclude some captive use.
[b]Cellulosics not included through 1962. Included beginning in 1963.
[c]SPI data used for 1971-1980
[d]***Chemical Economics Handbook,*** SRI International, Menlo Park, Cal.

	Compound Growth Rate	
	Total Production	Sales & Captive Use
1955-1980	9.4%	10.1%
1965-1980	7.6%	8.3%
1970-1980	6.3%	7.7%
1975-1980	10.4%	10.7%
1979-1980	—10.2%	—9.1%

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN*
(in millions of pounds)

Resin	1976		1977		1978		1979		1980		Compound Growth Rate 1975-1980 Sales & Captive Use
	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	
Epoxy	244	250	261	278	299	316	361	332	315	319	11.3%
Phenolic	1,340	1,305	1,458	1,400	1,617	1,543	1,781	1,732	1,499	1,517	8.0%
Polyester	1,042	959	1,061	1,045	1,209	1,199	1,147	1,152	947	949	4.2%
Urea	821	809	963	951	1,122	1,103	1,367	1,355	1,165	1,147	10.9%
Melamine	186	182	200	203	202	196	200	192	167	166	7.3%
Total Selected Thermosets	3,633	3,505	3,943	3,877	4,449	4,357	4,856	4,763	4,093	4,098	8.0%
ABS	988	925	1,069	1,057	1,134	1,118	1,191	1,183	920	916	8.1%
SAN	113	104	115	113	120	121	124	126	111	103	6.5%
HDPE	3,125	3,127	3,652	3,557	4,201	4,165	5,010	4,893	4,405	4,394	13.8%
LDPE	5,813	5,765	6,471	6,488	7,111	7,147	7,793	7,815	7,291	7,467	9.6%
Nylon	247	221	254	250	275	278	327	315	274	271	13.6%
Polypropylene	2,632	2,536	2,747	2,698	3,074	3,055	3,841	3,894	3,648	3,714	14.3%
Polystyrene	3,195	3,145	3,446	3,557	3,823	3,870	4,005	3,997	3,521	3,518	5.9%
PVC	4,716	4,638	5,253	5,232	5,723	5,810	6,119	6,138	5,470	5,407	8.4%
Thermoplastic Polyester	—	—	—	—	—	—	—	—	503	511	—
Total Selected Thermoplastics	20,829	20,461	23,007	22,952	25,461	25,564	28,410	28,361	26,143	26,301	10.4%
Total Selected Plastics	24,462	23,966	26,950	26,829	29,910	29,921	33,266	33,124	29,733	29,888	9.7%
All Other Plastics	4,734	3,018	6,998	4,227	7,695	5,142	8,311	5,593	7,111	4,786	15.4%
Grand Total	29,196	26,984	33,948	31,106	37,605	35,063	41,577	38,717	35,447	35,185	10.7%

*Sales & Captive Use excludes Polyurethane.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

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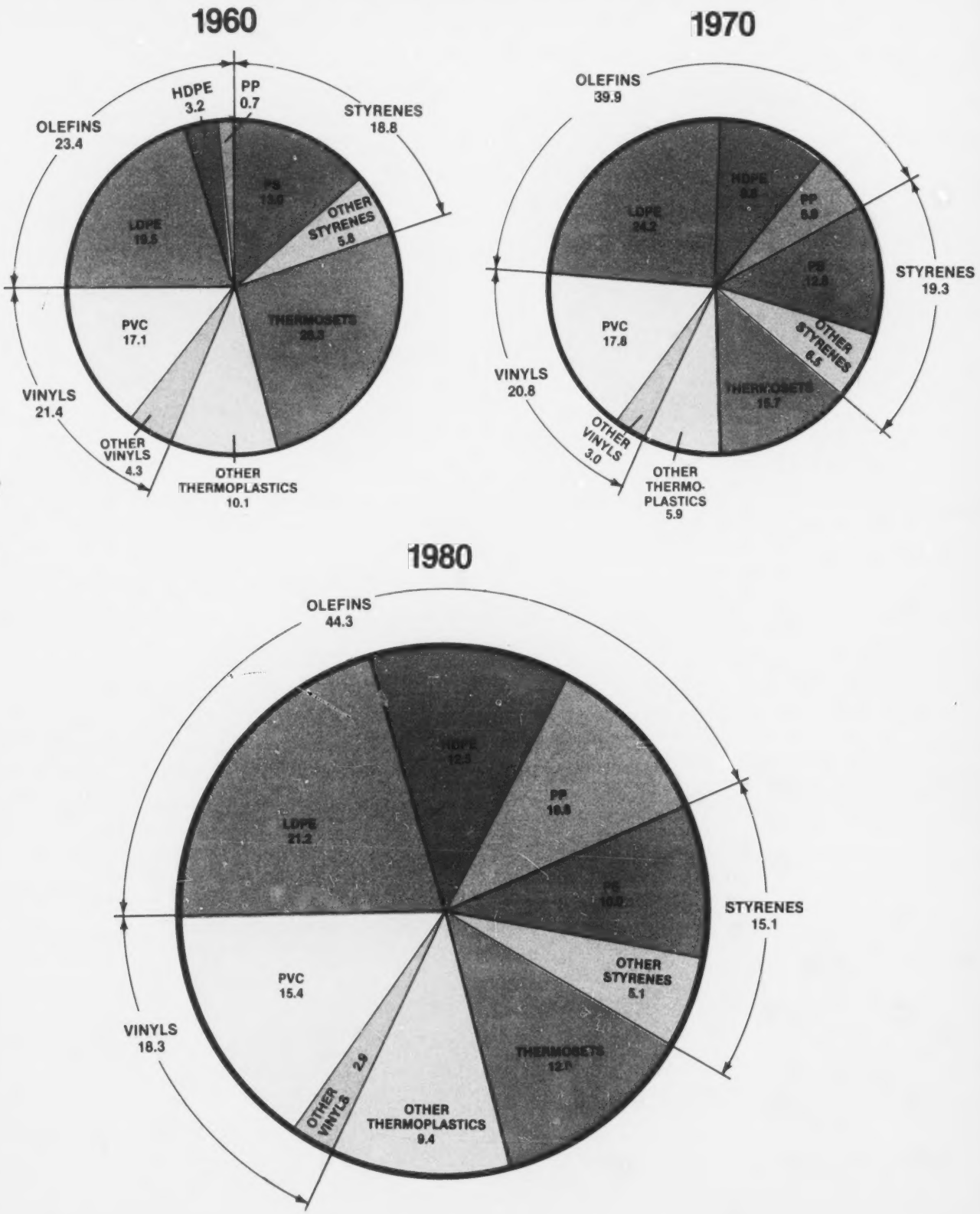
PERCENTAGE DISTRIBUTION OF PLASTIC SALES & CAPTIVE USE BY MATERIAL



PLASTICS RESINS DOMESTIC MERCHANT SALES
(in millions of dollars and millions of pounds)

Resin	1980		1979		% Change	
	Net Dollar Value	Quantity	Net Dollar Value	Quantity	Net Dollar Value	Quantity
Low Density Polyethylene	$ 1,974	5,323	$ 1,901	5,748	+ 3.8	- 7.4
Polystyrene	1,358	2,925	1,387	3,537	- 2.1	- 17.3
Polyvinyl Chloride	1,337	4,230	1,508	4,931	- 11.3	- 14.2
High Density Polyethylene	1,237	3,469	1,148	3,807	+ 7.8	- 8.9
Polypropylene	793	2,483	695	2,524	+ 1.2	- 1.6
Other Styrenes	554	669	374	731	+ 48.1	- 8.5
ABS	527	858	538	1,121	- 2.0	- 23.5
Polyester	510	881	580	1,072	- 12.1	- 17.8
Phenolic	495	1,107	509	1,364	- 2.8	- 18.8
Nylon	298	229	306	260	- 2.6	- 11.9
Epoxy	267	284	270	296	- 1.1	- 4.1
Urea	193	1,077	198	1,235	- 2.5	- 12.8
Other Vinyls	111	102	117	136	- 5.1	- 25.0
Polyvinyl Alcohol	96	115	86	121	+ 11.6	- 5.0
Melamine	89	123	93	145	- 4.3	- 15.2
SAN	50	85	48	103	+ 4.2	- 17.5
All other (excluding polyvinyl acetate and polyurethane)	2,793	3,085	2,517	3,183	+ 11.0	- 3.1
Total	$12,682	27,045	$12,275	30,314	+ 4.8	- 10.8

Domestic merchant sales are quantities of sales excluding interplant transfers, captive consumption and exports.

Net dollar value represents the actual selling price after deductions for cash discounts, quantity discounts, returned goods and allowances, federal excise taxes, local taxes, and outgoing transportation (prepaid or otherwise) to warehouses or customers.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

APPARENT U.S. CONSUMPTION OF SELECTED PLASTICS RESINS

Apparent consumption is calculated by adding imports to production then subtracting exports. It is an accurate measure of the quantity of material actually consumed in the United States.

For purposes of the table below, the production figures were taken from SPI's Monthly Statistical Report, as compiled by Ernst & Whinney. Both the import and export figures were taken from Bureau of the Census reports.

1980
(in millions of pounds)

Resin	Production	Imports	Exports	Apparent Consumption
Low Density Polyethylene	7,291	24	1,187	6,128
Polyvinyl Chloride	5,470	57	253	5,274
Polystyrene & Styrene Copolymers	4,306	16	352	3,970
High Density Polyethylene	4,405	104	711	3,798
Polypropylene	3,648	3	849	2,802
Phenolic	1,499	6	48	1,457
Urea	1,165	4	12	1,157
Acrylonitrile Butadiene Styrene	920	1	129	792
Unsaturated Polyester	947	1	163	785
Thermoplastic Polyester[a]	503	1	71	433
Epoxy	315	4	80	239
Nylon	274	2	42	234
Other Vinyls	196	2	29	169
Melamine	167	1	15	153
Polyvinyl Alcohol	141	21	24	138
Total of these resins	31,247	247	3,965	27,529
1979 Total	34,550	273	3,625	31,198
1978 Total	31,101	234	2,302	29,033
1977 Total	28,077	136	1,978	26,235
1976 Total	25,565	135	2,185	23,515

[a]Not included in earlier years

Source: Production—SPI Monthly Statistical Report, as compiled by Ernst & Whinney
Imports—Bureau of the Census, IM 146
Exports—Bureau of the Census, EM 546

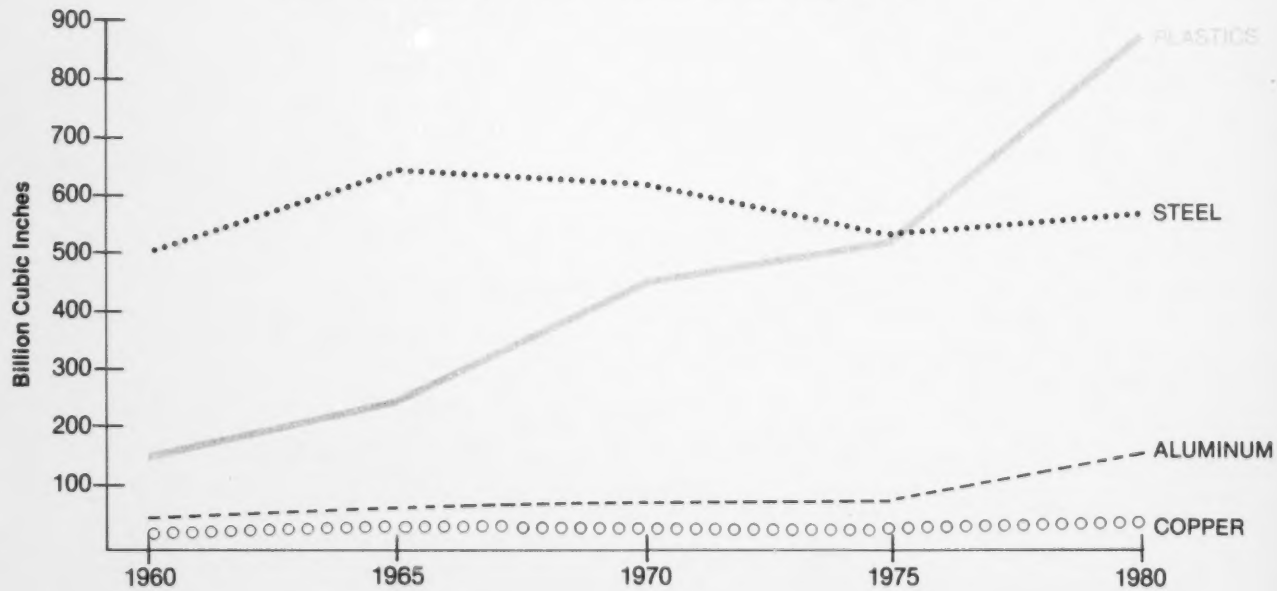
PLASTICS MATERIALS & RESINS
VALUE OF SHIPMENTS
(in millions of dollars)

Versus Largest Chemical Categories	1976	1977	1978	1979	1980	Compound Growth Rate 1975-1980
Industrial Organic Chemicals	20,645	23,840	26,100	31,800	35,600	16.0%
Drugs	13,020	14,435	15,900	17,760	19,975	12.2%
Plastics Materials & Resins	9,200	10,660	12,200	14,700	16,990	19.3%
Industrial Inorganic Chemicals	7,390	8,520	9,600	10,950	12,430	15.5%
Cosmetics	5,895	6,590	7,385	8,285	9,300	12.5%
Paints & Allied Products	5,930	6,660	7,320	8,125	8,700	11.1%
Cyclic Crudes & Intermediates	4,680	5,360	5,800	7,210	8,050	16.1%
Soaps & Detergents	5,200	5,640	6,270	6,985	7,800	10.8%
Phosphatic Fertilizers	2,440	2,665	2,900	3,700	4,550	10.7%
Nitrogenous Fertilizers	2,385	2,580	2,380	2,610	3,300	5.7%

Versus Other Commodities	1976	1977	1978	1979	1980	Compound Growth Rate 1975-1980
Steel	32,760	36,300	42,825	48,290	49,775	11.3%
Paper and Board	18,920	20,195	23,400	25,600	27,300	11.0%
Aluminum	10,935	13,095	15,830	17,760	19,270	18.0%
Cement and Concrete	11,420	13,270	16,085	17,880	18,860	12.0%
Plastics Materials & Resins	9,200	10,660	12,200	14,700	16,990	19.3%
Refined Copper	3,550	3,765	4,000	5,500	4,950	9.8%
Glass Containers	3,300	3,660	4,100	4,500	4,910	10.0%
Synthetic Rubber	1,700	1,865	2,010	2,255	2,325	9.8%
Leather Tanning & Finishing	1,325	1,490	1,665	2,050	2,075	13.8%
Primary Leads	710	700	720	900	820	2.5%

Source: Department of Commerce estimates.

SHIPMENTS BY VOLUME: PLASTICS VS. METALS



NOTE: Factors used in conversion—steel = .289 lbs/cu in
plastics = .04 lbs/cu in
aluminum = .098 lbs/cu in
copper = .321 lbs/cu in

NOTE: Plastics do not include polyurethane
SOURCE: American Iron and Steel Institute
SPI
U.S. Bureau of the Census

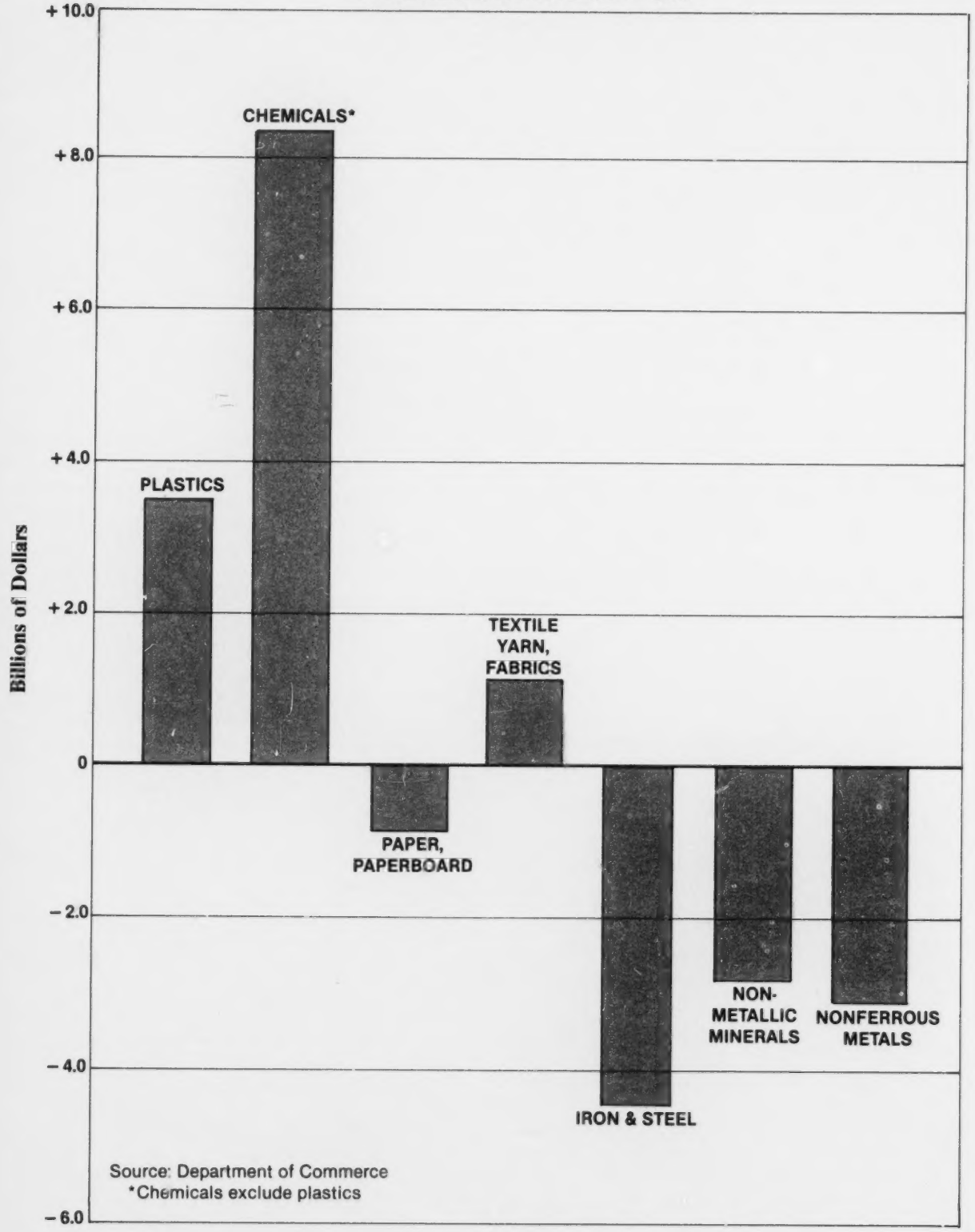
GENERAL ECONOMIC STATISTICS

COMMODITY — BALANCE OF TRADE
(in millions of dollars)

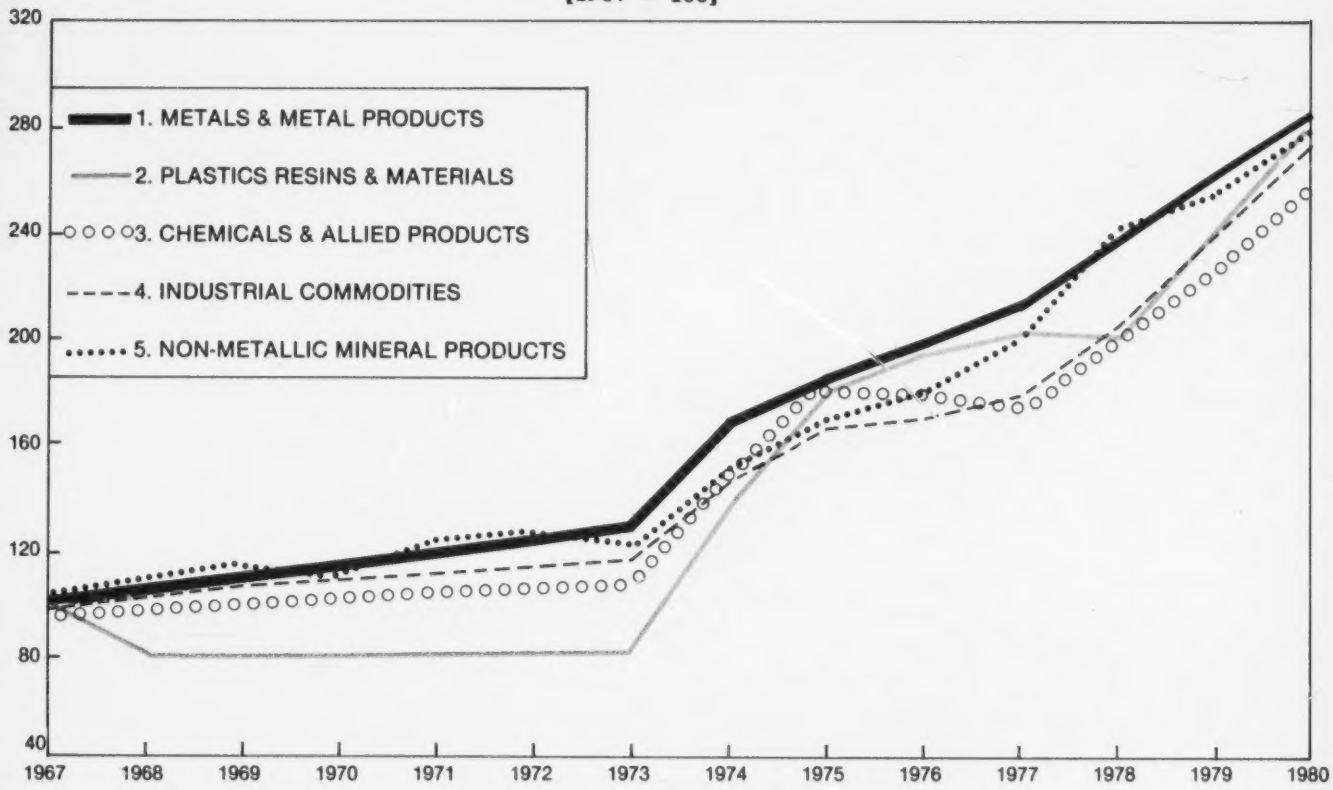
	Exports	Imports	Difference
Plastics Materials & Resins			
1976	1,672	321	+ 1,351
1977	1,733	401	+ 1,332
1978	2,088	566	+ 1,522
1979	3,240	641	+ 2,599
1980	3,884	652	+ 3,232
Chemicals (except plastics)			
1976	8,286	4,507	+ 3,779
1977	9,094	5,057	+ 4,037
1978	10,530	6,212	+ 4,318
1979	14,066	6,877	+ 7,189
1980	16,356	7,891	+ 8,465
Paper, Paperboard			
1976	1,624	2,103	– 479
1977	1,517	2,405	– 888
1978	1,597	3,024	– 1,427
1979	1,967	3,331	– 1,364
1980	2,831	3,534	– 703
Textile Yarn, Fabrics			
1976	1,970	1,653	+ 317
1977	1,959	1,790	+ 169
1978	2,225	2,400	– 175
1979	3,189	2,237	+ 952
1980	3,632	2,504	+ 1,128
Iron and Steel			
1976	1,906	4,513	– 2,607
1977	1,660	5,993	– 4,333
1978	1,714	8,034	– 6,320
1979	2,342	7,620	– 5,278
1980	3,122	7,509	– 4,387
Nonmetallic Minerals, n.e.c.			
1976	1,166	2,114	– 948
1977	1,275	2,815	– 1,540
1978	1,597	4,086	– 2,489
1979	1,949	4,065	– 2,116
1980	2,209	4,680	– 2,471
Nonferrous Metals			
1976	1,185	3,494	– 2,309
1977	1,150	3,946	– 2,796
1978	1,281	5,259	– 3,978
1979	2,152	6,314	– 4,162
1980	4,743	7,612	– 2,869

Source: U.S. Dept. of Commerce; FT 135(U.S. Imports), FT 410(U.S. Exports)

U.S. BALANCE OF TRADE—1980



PRODUCER PRICE INDEXES
[1967 = 100]



COMMODITY GROUP	1972	1974	1976	1978	1980
NON-METALLIC MINERAL PRODUCTS	126.1	153.2	186.3	228.8	282.9
METALS & METAL PRODUCTS	123.5	171.9	195.9	227.1	286.4
INDUSTRIAL COMMODITIES	117.9	153.8	182.4	209.4	274.3
CHEMICALS & ALLIED PRODUCTS	104.2	146.8	187.2	198.8	260.3
PLASTICS RESINS & MATERIALS	88.7	143.8	194.0	199.9	279.5

Source: Bureau of Labor Statistics, U.S. Department of Labor.

WHAT IS SIC?

The Standard Industrial Classification System (SIC) classifies all manufacturing and services produced in the U.S. It starts with the broadest industrial aggregations; then, by a series of subdivisions, it identifies more finely detailed classes or groupings right down to the individual product level. Thus at the first level there is the manufacturing sector. At the next level of detail, manufacturing is divided into twenty 2-digit *Major Groups,* such as SIC 28, CHEMICALS. Those are subdivided into 3-digit *Industry Groups,* of which there are 143, such as 282, plastics and synthetic fibers.

The next level is made up of 4-digit *Specific Industries,* of which there are 457, including SIC 2821, plastics resins and materials. This level of detail is the one used in the "Survey of Industrial Purchasing Power."

A complete list of industries, and their definitions, appears in the "Standard Industrial Classification Manual, available from the U.S. Government Printing Office, Washington, D.C. 20402; price $6.75.

The basic reporting unit in the SIC is the individual establishment, such as a factory, plant or mill, engaged primarily in manufacturing products and thus distinguished from a central administrative office or other auxiliary units. Also, an establishment is not necessarily identical with the business firm, which may consist of more than one such facility.

		1980		
		Number of Plants		Shipments
SIC	Industry	Total Plants	Employment	($Mil.)
SIC 28 Chemicals				
2812	Alkalies & chlorine	73	20,939	2,104.2
2813	Industrial gases	335	16,728	1,582.0
2816	Inorganic pigments	101	14,582	1,589.6
2819	Industrial inorganic chemicals n.e.c.	539	89,121	10,769.0
2821	**Plastics materials & synthetic resins**	472	91,610	13,713.8
2822	Synthetic rubber	62	26,246	2,405.2
2823	Cellulosic man-made fibers	22	20,410	1,335.0
2824	Noncellulosic synthetic organic fibers	60	68,450	8,498.1
2831	Biological products	83	12,275	1,308.9
2833	Medicinals & botanicals	100	23,052	2,953.6
2834	Pharmaceutical preparations	461	131,769	16,582.4
2841	Soap & other detergents	263	36,705	7,957.2
2842	Polishes & sanitation goods	525	42,894	4,391.1
2843	Surface-active agents	73	5,298	1,613.7
2844	Toilet preparations	260	57,523	9,225.7
2851	Paints & allied products	879	70,932	8,477.9
2861	Gum & wood chemicals	89	7,574	526.1
2865	Cyclic crudes & intermediates	188	29,332	6,781.5
2869	Industrial organic chemicals n.e.c.	449	99,921	30,158.4
2873	Nitrogenous fertilizers	220	20,427	3,317.9
2874	Phosphatic fertilizers	88	18,012	3,526.3
2875	Fertilizers—mixing only	272	13,467	2,475.9
2879	Agricultural chemicals n.e.c.	204	19,906	3,720.0
2891	Adhesives & sealants	310	26,416	2,620.4
2892	Explosives	62	14,099	882.9
2893	Printing ink	213	12,094	1,259.8
2895	Carbon black	34	3,313	619.2
2899	Chemical preparations n.e.c.	637	50,366	5,331.9
SIC 30 Rubber & misc. plastics				
3011	Tires & inner tubes	129	104,289	10,225.8
3021	Rubber & plastic footwear	48	22,468	589.2
3031	Reclaimed rubber	17	1,113	45.0
3041	Rubber & plastic hose & belting	164	32,097	1,565.8
3069	Fabricated rubber products n.e.c.	872	120,986	4,598.6
3079	**Miscellaneous plastics products**	4,547	407,102	25,632.4

Source: *Sales & Marketing Management's 1981 Survey of Industrial Purchasing Power, U.S. Dept. of Commerce.*

PROFILE OF 50 BIGGEST MANUFACTURING INDUSTRIES

1980 Rank	SIC	Industry	1980 Shipments ($ Mil.)	Total Plants	Shipments Per Plant ($000)	% Shipments Large Plants
1.	2911	Petroleum refining	$156,406	334	$468,283	92%
2.	3711	Motor vehicles & car bodies	67,229	162	414,994	99
3.	3312	Blast furnaces & steel mills	50,564	341	148,280	98
4.	2011	Meat packing plants	38,797	1,112	34,890	80
5.	3714	Motor vehicle parts & accessories	31,531	1,244	25,347	93
6.	2869	Industrial organic chemicals, NEC	30,158	449	67,168	89
7.	**3079**	**Miscellaneous plastics products**	25,632	4,547	5,637	65
8.	3573	Electronic computing equipment	24,176	531	45,530	95
9.	3662	Radio & tv communication equipment	23,510	1,104	21,295	90
10.	3721	Aircraft	22,832	99	230,621	99
11.	2621	Paper mills, except building paper	18,589	348	53,416	97
12.	3585	Refrigeration & heating equipment	17,310	534	32,416	89
13.	2026	Fluid milk	16,824	981	17,150	68
14.	2834	Pharmaceutical preparations	16,582	461	35,970	92
15.	3531	Construction machinery	16,248	481	33,779	92
16.	2711	Newspapers	16,084	2,435	6,605	76
17.	3861	Photographic equipment & supplies	15,275	392	38,967	86
18.	**2821**	**Plastics materials & resins**	13,714	472	29,055	87
19.	2086	Bottled & canned soft drinks	12,956	1,591	8,143	58
20.	3661	Telephone & telegraph apparatus	12,713	223	57,010	97
21.	2421	Sawmills & planing mills, general	12,464	1,973	6,317	57
22.	3465	Automotive stamping	12,302	195	63,088	96
23.	2752	Commercial printing, lithographic	11,773	1,811	6,501	52
24.	2048	Prepared feeds, NEC	11,287	1,002	11,265	36
25.	2051	Bread, cake & related products	11,219	1,421	7,895	82
26.	3523	Farm machinery & equipment	11,041	862	12,809	80
27.	3599	Machinery, except electrical, NEC	10,997	3,081	3,569	36
28.	3724	Aircraft engines & engine parts	10,828	154	70,310	96
29.	2013	Sausage & other prepared meats	10,784	688	15,674	69
30.	2819	Industrial inorganic chemicals, NEC	10,769	539	19,980	84
31.	2631	Paperboard mills	10,486	209	50,172	94
32.	3011	Tires and inner tubes	10,226	129	79,270	88
33.	2111	Cigarettes	10,086	12	840,492	100
34.	2075	Soybean oil mills	9,873	77	127,052	54
35.	3357	Nonferrous wire drawing & insulating	9,334	266	35,090	91
36.	3273	Ready-mixed concrete	9,330	1,480	6,304	34
37.	3519	Internal combustion engines, NEC	9,295	122	76,189	96
38.	2844	Toilet preparations	9,226	260	35,483	91
39.	2022	Cheese, natural & processed	9,002	310	29,039	66
40.	3443	Fabricated plate work, boiler shops	8,842	1,132	7,811	75
41.	2082	Malt beverages	8,641	98	97,091	89
42.	3411	Metal cans	8,512	373	22,821	88
43.	2824	Organic fibers, noncellulosic	8,498	60	141,635	99
44.	2851	Paints & allied products	8,478	879	9,645	61
45.	3353	Aluminum sheet, plate & foil	8,427	62	135,911	96
46.	2653	Corrugated & soild fiber boxes	8,420	1,075	7,832	75
47.	3731	Ship building & repairing	8,179	301	27,172	95
48.	3321	Gray iron foundries	8,153	783	10,412	84
49.	2099	Food preparations, NEC	8,051	755	10,664	68
50.	2841	Soap & other detergents	7,957	263	30,256	80
		50-industry total	$919,519	38,204	$24,069	86%

N.A.: Not available. n.e.c.: Not elsewhere classified.

Definitions: **Shipments:** Output of all manufacturing plants. **No. of Plants:** Manufacturing establishments with 20 or more employees.

Average Shipments per plant: A mathematical average, computed by dividing number of plants into total shipments. % Large Plants: Share of shipments accounted for by plants with 100 or more employees.

Sources: *Sales & Marketing Management's 1981 Survey of Industrial Purchasing Power,* U.S. Commerce Dept.: *U.S. Industrial Outlook 1981.*

INDUSTRY FINANCIAL PERFORMANCE — 1979

RETURN ON SALES
THE INDUSTRY MEDIANS

	1979	1978
Pharmaceuticals	8.9%	8.7%
Mining, crude-oil production	8.7	8.1
Broadcasting, motion-picture production and distribution	8.3	9.6
Publishing, printing	8.2	8.4
Tobacco	7.7	6.4
Office equipment (includes computers)	7.0	7.9
Measuring, scientific, photographic equipment	6.9	7.3
Petroleum refining	6.6	4.7
Soaps, cosmetics	6.4	6.4
Paper, fiber, and wood products	6.3	5.3
Chemicals	6.0	5.6
Industrial and farm equipment	5.4	5.5
Electronics, appliances	5.2	4.8
Beverages	5.1	4.1
Metal products	5.0	5.5
Glass, concrete, abrasives, gypsum	4.9	5.8
Aerospace	4.8	4.6
Metal manufacturing	4.6	3.3
Apparel	4.4	3.3
Shipbuilding, railroad and transportation equipment	4.2	4.3
Motor vehicles	4.1	4.2
Musical instruments, toys, sporting goods	3.9	4.0
Textiles, vinyl flooring	3.8	3.8
Food	3.0	2.8
Rubber, plastic products	2.8	2.7
Leather	N.A.	N.A.
Furniture	N.A.	N.A.
Jewelry, silverware	N.A.	N.A.
All industries	5.2	4.8

CHANGES IN SALES
THE INDUSTRY MEDIANS

Mining, crude-oil production	41.4 %
Petroleum refining	32.1
Aerospace	21.8
Shipbuilding, railroad and transportation equipment	20.0
Measuring, scientific, photographic equipment	18.6
Metal manufacturing	18.4
Metal products	18.2
Office equipment (includes computers)	17.6
Chemicals	17.1
Tobacco	16.6
Beverages	16.4
Pharmaceuticals	16.3
Publishing, printing	16.1
Industrial and farm equipment	15.9
Soaps, cosmetics	15.9
Electronics, appliances	15.1
Paper, fiber, and wood products	13.8
Food	13.8
Glass, concrete, abrasives, gypsum	12.3
Broadcasting, motion-picture production and distribution	11.7
Apparel	11.6
Motor vehicles	10.9
Textiles, vinyl flooring	10.5
Musical instruments, toys, sporting goods	10.5
Rubber, plastic products	10.0
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.

SALES PER EMPLOYEE
THE INDUSTRY MEDIANS

Petroleum refining	$356,066
Mining, crude-oil production	129,343
Food	100,179
Broadcasting, motion-picture production and distribution	99,626
Beverages	92,146
Tobacco	89,739
Metal manufacturing	89,586
Chemicals	84,239
Paper, fiber, and wood products	82,530
Soaps, cosmetics	76,568
Shipbuilding, railroad and transportation equipment	74,044
Publishing, printing	66,514
Motor vehicles	66,100
Pharmaceuticals	66,033
Glass, concrete, abrasives, gypsum	64,716
Rubber, plastic products	60,082
Industrial and farm equipment	59,251
Metal products	58,796
Aerospace	55,542
Electronics, appliances	48,021
Musical instruments, toys, sporting goods	47,143
Office equipment (includes computers)	45,710
Measuring, scientific, photographic equipment	45,404
Textiles, vinyl flooring	40,479
Apparel	32,927
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.
All industries	71,555

TOTAL RETURN TO INVESTORS
THE INDUSTRY MEDIANS

Mining, crude-oil production	80.54%
Petroleum refining	61.29
Aerospace	44.46
Broadcasting, motion-picture production and distribution	36.98
Chemicals	33.90
Shipbuilding, railroad and transportation equipment	25.18
Measuring, scientific, photographic equipment	23.08
Metal products	22.11
Publishing, printing	21.59
Paper, fiber, and wood products	20.77
Metal manufacturing	20.57
Electronics, appliances	19.81
Industrial and farm equipment	17.47
Textiles, vinyl flooring	17.37
Food	15.37
Glass, concrete, abrasives, gypsum	14.96
Apparel	14.71
Office equipment (includes computers)	14.71
Tobacco	14.70
Pharmaceuticals	13.62
Motor vehicles	12.01
Musical instruments, toys, sporting goods	5.08
Beverages	1.38
Rubber, plastic products	– 6.74
Soaps, cosmetics	– 7.03
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.
All industries	21.31

Source: "The Fortune Directory of the 500 Largest U.S. Industrial Corporations"

INDUSTRY FINANCIAL PERFORMANCE — 1979

TOTAL RETURN TO INVESTORS, 1969-79
THE INDUSTRY MEDIANS

Mining, crude-oil production	15.43%
Aerospace	14.76
Broadcasting, motion-picture production and distribution	14.04
Tobacco	13.56
Petroleum refining	13.28
Industrial and farm equipment	10.03
Metal products	9.61
Metal manufacturing	7.89
Chemicals	7.53
Food	6.37
Shipbuilding, railroad and transportation equipment	6.27
Measuring, scientific, photographic equipment	5.85
Textiles, vinyl flooring	5.83
Paper, fiber and wood products	5.74
Motor vehicles	4.71
Publishing, printing	4.24
Electronics, appliances	4.10
Pharmaceuticals	4.03
Glass, concrete, abrasives, gypsum	3.01
Soaps, cosmetics	2.83
Beverages	1.93
Office equipment (includes computers)	.86
Rubber, plastic products	.54
Musical instruments, toys, sporting goods	.19
Apparel	– .96
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.
All industries	6.58

CHANGES IN PROFITS
THE INDUSTRY MEDIANS

Petroleum refining	78.3%
Mining, crude-oil production	73.2
Metal manufacturing	34.4
Aerospace	26.6
Paper, fiber and wood products	25.1
Office equipment (includes computers)	24.6
Tobacco	24.3
Chemicals	24.0
Metal products	21.4
Apparel	21.2
Beverages	18.9
Electronics, appliances	18.4
Measuring, scientific, photographic equipment	18.1
Rubber, plastic products	17.8
Motor vehicles	16.3
Industrial and farm equipment	16.3
Shipbuilding, railroad and transportation equipment	16.1
Pharmaceuticals	15.5
Publishing, printing	15.3
Soaps, cosmetics	14.7
Food	14.5
Glass, concrete, abrasives, gypsum	13.2
Broadcasting, motion-picture production and distribution	9.4
Textiles, vinyl flooring	9.1
Musical instruments, toys, sporting goods	7.0
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.

ASSETS PER EMPLOYEE
THE INDUSTRY MEDIANS

Petroleum refining	$266,397
Mining, crude-oil production	181,647
Broadcasting, motion-picture production and distribution	101,626
Tobacco	80,792
Chemicals	68,995
Paper, fiber, and wood products	66,981
Metal manufacturing	64,257
Beverages	62,408
Pharmaceuticals	61,726
Publishing, printing	51,784
Soaps, cosmetics	46,890
Glass, concrete, abrasives, gypsum	45,866
Industrial and farm equipment	44,614
Food	44,477
Metal products	43,515
Office equipment (includes computers)	43,103
Rubber, plastic products	38,947
Motor vehicles	37,768
Shipbuilding, railroad and transportation equipment	37,497
Electronics, appliances	34,715
Musical instruments, toys, sporting goods	33,787
Measuring, scientific, photographic equipment	33,725
Aerospace	32,139
Textiles, vinyl flooring	25,294
Apparel	19,970
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.
All industries	49,472

RETURN ON STOCKHOLDERS' EQUITY
THE INDUSTRY MEDIANS

	1979	1978
Broadcasting, motion-picture production and distribution	22.2%	21.6%
Aerospace	19.2	15.6
Petroleum refining	19.1	13.4
Tobacco	18.4	15.8
Shipbuilding, railroad and transportation equipment	18.1	15.9
Pharmaceuticals	18.0	17.6
Publishing, printing	17.9	15.8
Soaps, cosmetics	17.4	16.7
Mining, crude-oil production	16.7	10.1
Electronics, appliances	16.3	14.9
Measuring, scientific, photographic equipment	16.1	15.0
Metal products	16.0	15.3
Office equipment (includes computers)	15.9	15.7
Paper, fiber, and wood products	15.9	12.9
Motor vehicles	15.7	15.4
Beverages	15.7	10.5
Apparel	15.6	15.6
Metal manufacturing	15.6	10.4
Industrial and farm equipment	15.4	15.2
Chemicals	15.2	13.1
Food	14.4	13.7
Glass, concrete, abrasives, gypsum	14.0	13.9
Musical instruments, toys, sporting goods	12.1	10.9
Textiles, vinyl flooring	11.7	11.2
Rubber, plastic products	8.2	10.7
Leather	N.A.	N.A.
Furniture	N.A.	N.A.
Jewelry, silverware	N.A.	N.A.
All industries	15.9	14.3

Source: "The Fortune Directory of the 500 Largest U.S. Industrial Corporations"

SALES OF MAJOR PLASTICS PRODUCING COMPANIES
(rounded to nearest $25 million)

	Plastics Sales[1]		Chemicals Sales[2]		Total Sales	
Company[3]	1980	1979	1980	1979	1980	1979
1 Dow Chemical	3,850	3,550	9,800	7,575	10,625	9,250
2 DuPont	3,000	2,825	5,150	4,975	13,650	12,575
3 Dart & Kraft	1,875	1,925	1,875	1,925	9,400	8,825
4 Monsanto	1,375	1,425	4,950	4,625	6,575	6,200
5 Union Carbide	1,100	1,000	3,650	3,350	10,000	9,175
6 Standard Oil (Indiana)	900	850	2,875	2,550	27,825	20,200
7 Exxon	800	800	6,925	5,800	108,450	83,550
8 Hercules	700	675	2,250	2,050	2,475	2,350
9 Reichhold Chemicals	650	650	800	800	875	875
10 B.F. Goodrich	625	650	1,025	1,050	3,075	3,000
11 Shell Oil	575	475	3,100	2,600	19,950	14,450
12 Gulf Oil	550	500	2,450	2,300	28,800	26,150
13 Mobay Chemical	500	450	1,075	950	1,075	950
13 Atlantic Richfield	500	550	2,500	2,250	24,150	16,675
15 Phillips Petroleum	475	425	2,250	2,050	13,375	9,500
16 W.R. Grace	450	400	3,025	2,625	6,100	5,300
16 Borg Warner	450	450	625	600	2,675	2,725
18 Ethyl	425	400	1,525	1,450	1,750	1,650
19 General Electric	400	375	400	375	25,525	22,975
19 Occidental Petroleum	400	375	2,575	2,075	12,475	9,550
21 U.S. Steel	375	300	1,475	1,250	12,500	12,925
22 Rohm and Haas	350	350	1,600	1,475	1,725	1,600
23 Celanese	325	325	1,475	1,425	3,350	3,150
24 Goodyear Tire & Rubber	300	300	925	900	8,450	8,250
25 Cities Service	250	250	550	525	7,775	6,275
26 National Distillers	225	225	825	825	2,050	2,050
26 Certain Teed	225	275	225	275	875	925
28 Allied Corp.	200	225	2,400	2,150	5,525	4,325
28 Internorth	200	225	350	325	3,025	2,500
28 Tenneco	200	200	1,650	1,475	13,225	11,200
28 Eastman Kodak	200	175	2,075	1,775	9,725	8,025
32 Diamond Shamrock	175	250	1,350	1,275	3,150	2,350
32 Borden	175	175	1,550	1,450	4,600	4,300
34 Conoco Oil	150	200	900	825	18,775	13,075
34 Stauffer Chemical	150	150	1,100	1,025	1,700	1,525
36 Air Products & Chemicals	125	150	525	450	1,425	1,225

[1] Includes fabricated plastics products.
[2] Includes plastics.
[3] Ranked by plastics sales in 1980.

Source: Company annual reports, industry estimates.

PROPRIETARY PROCESSORS BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	Operating Statements	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
2.3	1.4	0.5	Freight Out & Warehousing	1.6	1.8	2.0
2.6	2.0	1.4	Direct Packaging & Shipping Supplies	2.6	2.4	2.2
44.6	39.9	34.9	Direct Materials	45.4	44.4	40.6
10.8	11.0	11.1	Direct Labor	10.8	10.5	10.2
5.7	5.6	5.4	Indirect Labor	8.8	7.9	7.1
3.0	2.7	2.1	Utilities	2.7	2.6	2.6
3.4	3.7	3.9	Other Variable Mfg. Expense	5.2	5.0	4.7
4.5	3.8	3.0	Depreciation Expense	3.1	2.9	2.7
2.1	1.6	1.1	Lease Expense	0.5	0.8	1.1
1.5	1.9	2.2	Other Fixed Mfg. Expense	1.5	1.5	1.6
0.4	0.6	0.8	Net on Tool Transactions	(0.3)	(0.1)	0.2
1.1	2.7	4.3	Sales Commissions	1.4	2.0	2.5
4.2	4.2	4.2	Other Sales Expense	4.0	4.6	5.2
8.7	8.1	7.5	Administrative Expense	6.3	6.1	5.9
5.1	10.8	17.6	Operating Earnings	6.4	7.6	11.4
N.A.	2.1	4.2	Engineering Expense	3.4	1.6	1.2
3.3	2.9	2.5	Research & Development Expense	0.5	0.7	1.0
1.5	1.4	1.3	Interest	1.7	1.1	0.6
2.1	1.3	0.5	Misc. (Income) or Expense	(1.2)	(0.6)	0.1
(1.8)	3.1	9.1	Profit Before Income Taxes	2.0	4.8	8.5
(0.4)	1.3	4.7	Federal Income Tax	0.6	1.8	3.0
0.1	0.3	0.6	Other Income Taxes	0.1	0.3	0.8
(1.5)	1.5	3.8	PROFIT AFTER INCOME TAXES	1.3	2.7	4.7
118.0%	128.8%	139.5%	Sales as Percentage of Total Assets	178.6%	170.3%	162.0%
			Balance Sheets			
1.7	2.8	3.9	Cash & Equivalents	0.9	2.2	3.4
21.9	22.8	23.3	Accounts & Notes Receivable	22.3	23.7	25.1
6.4	8.2	10.5	Raw Material Inventory	8.6	8.1	7.7
10.7	7.0	3.3	Work in Process Inventory	4.0	3.5	2.9
3.3	5.8	7.3	Finished Goods Inventory	11.5	13.7	16.0
2.1	2.4	2.5	LIFO Reserve	8.2	7.6	6.9
0.2	0.2	0.2	Packaging & Shipping Supplies	1.4	1.2	1.0
0.7	1.1	1.6	Other Current Assets	2.4	2.3	2.1
42.8	45.5	47.6	CURRENT ASSETS	42.9	47.1	51.3
26.3	25.8	25.4	Land & Buildings, at Cost	24.9	23.6	22.3
4.7	5.6	6.4	Depreciation Reserve	7.0	6.9	6.8
55.0	47.8	41.1	Machinery & Equipment, at Cost	54.1	49.6	45.1
24.0	16.9	9.7	Depreciation Reserve	22.0	21.8	21.5
5.7	5.0	4.2	Molds, Tools, & Dies, at Cost	5.1	9.5	13.8
4.6	3.9	3.3	Depreciation Reserve	3.4	5.8	8.2
3.5	2.3	1.1	Other Long-Term Assets	5.4	4.7	4.0
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
1.1	1.7	2.3	Current Portion of Term Debt	2.8	2.2	1.5
12.3	8.0	3.7	Notes Payable	19.8	11.5	3.2
11.2	10.2	9.2	Accounts Payable, Trade	8.7	7.9	7.1
6.8	6.3	5.7	Other Payables & Accruals	6.6	6.5	6.4
(0.6)	2.1	4.8	Provision for Income Taxes	2.7	3.6	4.5
30.8	28.3	25.7	CURRENT LIABILITIES	40.6	31.7	22.7
38.0	25.5	13.1	Real Estate Mortgages	5.5	9.0	12.6
4.2	8.5	12.7	Other Long-Term Debt	16.4	13.3	10.1
73.0	62.3	51.5	TOTAL LIABILITIES	62.5	54.0	45.4
27.0	37.7	48.5	EQUITY (NET WORTH)	37.5	46.0	54.6
			Statistical Data			
$48,000	$51,110	$54,220	Net Sales/Number of All Employees	$55,382	$58,073	$60,763
38.6%	35.2%	31.8%	Prod. Man Hrs./Available Mach. Hrs.	63.9%	63.3%	62.6%
$30.00	$27.53	$25.05	Net Sales/All Employees Man Hours	$29.78	$29.22	$28.65
295.0%	284.3%	273.5%	Net Sales/Total Employment Costs	273.0%	286.1%	335.1%
$31.00	$31.76	$32.52	Net Sales/Production Worker Man Hrs.	$43.86	$46.43	$49.00
516.0%	463.8%	411.5%	Net Sales/Prod. Worker Emp. Costs	489.2%	507.0%	524.8%
$.76	$.99	$1.21	Net Sales—Cost of Matls./lbs. Proc.	$.74	$.89	$1.03
$.24	$.27	$.30	Total Mfg. Payroll/lbs. Processed	$.21	$.23	$.25
4.5%	7.3%	10.0%	Percent Change in Sales, '80 vs '79	7.7%	10.6%	12.4%
70.3	71.6	74.2	Cost of Sales/Inventory (Days)	39.5	47.5	59.3
67.7	64.6	62.0	Average Collection Period (Days)	45.6	50.8	56.6
(2.1%)	4.0%	12.7%	Profit Before Income Taxes/Assets	3.6%	8.2%	13.8%
1.6%	3.1%	10.4%	Profit Before Income Taxes/Gross Assets	2.5%	5.8%	9.6%
3.3%	6.0%	8.5%	Cash Return/Gross Assets	6.7%	3.5%	8.7%
(6.6%)	5.1%	10.9%	Net Income/Equity	6.2%	10.0%	13.9%
3.3%	2.9%	2.6%	Research & Development Expense/Net Sales	0.5%	0.7%	1.0%

*Less or More than Median Profits before Taxes of 0.0%

**Less or More than Median Profits before Taxes of 0.0%

Source: SPI Financial & Operating Ratios Survey #19

PROPRIETARY PROCESSORS BY SALES GROUPS – 1979

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	Operating Statements	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
2.5	1.3	0.9	Freight Out & Warehousing	3.5	2.9	2.2
43.9	38.6	34.1	Direct Materials	45.5	42.6	40.7
7.9	13.3	13.6	Direct Labor	12.0	11.5	10.9
5.9	6.9	8.0	Indirect Labor	6.4	7.0	7.5
3.3	2.0	1.7	Utilities	3.0	2.8	2.5
5.5	7.7	10.3	Other Variable Mfg. Expense	5.0	4.8	4.7
5.1	4.4	3.8	Depreciation & Lease Payments	4.1	3.5	2.9
2.2	1.7	1.1	Other Fixed Mfg. Expense	2.3	2.4	2.5
1.8	0.9	0.8	Net on Tool Transactions	0.3	0.6	0.8
0.9	1.1	1.5	Sales Commissions	2.4	2.2	2.2
2.3	4.9	5.0	Other Sales Expense	4.1	4.9	5.4
14.1	8.4	7.0	Administrative Expense	5.8	5.9	5.9
1.1	1.8	1.9	Interest	1.3	1.1	0.7
(.1)	(.1)	(.1)	Misc. Income or (Expense)	0.5	0.5	0.4
3.6	7.1	10.4	Profit Before Income Taxes	3.8	7.3	10.7
0.8	2.2	3.8	Federal Income Tax	1.4	2.7	4.1
0.1	0.1	0.1	Other Income Taxes	0.1	0.3	0.5
2.7	4.8	6.5	PROFIT AFTER INCOME TAXES	2.3	4.3	6.1
202.7%	192.0%	181.1%	Sales as Percentage of Total Assets	164.7%	171.6%	178.0%
			Balance Sheets			
4.7	3.0	3.0	Cash & Equivalents	2.3	2.0	1.7
28.0	35.4	35.4	Accounts & Notes Receivable	24.2	23.7	23.2
9.1	8.8	8.4	Raw Material Inventory	7.9	8.4	9.0
3.9	4.7	5.7	Work in Process Inventory	4.1	4.3	4.3
4.0	7.4	9.8	Finished Goods Inventory	10.2	12.6	15.0
4.2	2.1	2.1	Other Current Assets	1.9	2.1	2.2
53.9	61.4	64.4	CURRENT ASSETS	50.6	53.1	55.4
20.3	20.3	19.9	Land & Buildings, at Cost	21.0	22.4	22.9
1.0	2.2	2.2	Depreciation Reserve	5.8	5.7	5.5
32.9	40.3	40.4	Machinery & Equipment, at Cost	55.0	50.7	47.0
15.9	24.3	24.9	Depreciation Reserve	26.3	28.3	30.2
11.1	5.5	4.5	Molds, Tools, & Ties, at Cost	7.2	9.4	11.7
5.3	4.0	3.9	Depreciation Reserve	4.0	4.6	5.1
4.0	3.0	1.8	Other Long-Term Assets	2.3	3.0	3.8
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
0.4	3.8	3.8	Current Portion of Term Debt	3.9	2.4	0.7
17.6	16.0	15.3	Notes Payable	8.3	5.9	3.8
13.1	13.7	13.8	Accounts Payable, Trade	11.8	9.5	8.3
6.3	6.3	6.2	Other Payables & Accruals	5.2	4.9	4.9
1.8	2.7	3.5	Provision for Income Taxes	2.1	3.0	3.8
39.2	42.5	42.6	CURRENT LIABILITIES	31.3	25.7	21.5
8.2	5.3	5.2	Real Estate Mortgages	12.2	8.0	2.3
8.3	13.8	15.5	Other Long-Term Debt	14.6	11.3	7.6
55.7	61.6	63.3	TOTAL LIABILITIES	58.1	45.0	31.4
44.3	38.4	36.7	EQUITY (NET WORTH)	41.9	55.0	68.6
			Statistical Data			
$34,775	$44,295	$46,500	Net Sales/Number of All Employees	$46,643	$47,561	$48,417
60.0%	60.0%	87.0%	Prod. Man Hrs./Available Mach. Hrs.	194.0%	137.2%	48.9%
$21.07	$22.37	$23.94	Net Sales/All Employees Man Hours	$25.90	$25.49	$24.09
275.0%	339.1%	433.9%	Net Sales/Total Employment Costs	358.7%	361.5%	364.0%
$46.49	$42.93	$33.87	Net Sales/Production Worker Man Hrs.	$39.52	$36.70	$34.00
739.6%	398.0%	398.0%	Net Sales/Prod. Worker Emp. Costs	513.5%	511.3%	509.4%
$.81	$.81	$.51	Net Sales—Cost of Matls./lbs. Proc.	$.83	$.97	$1.05
$.29	$.28	$.25	Total Mfg. Payroll/lbs. Processed	$.22	$.25	$.29
10.5%	15.4%	16.7%	Percent Change in Sales, '78 vs '77	15.5%	15.3%	15.1%
29.5	51.7	64.8	Cost of Sales/Inventory (Days)	59.9	68.9	77.7
50.4	67.3	71.3	Average Collection Period (Days)	53.6	50.4	45.6
16.5%	35.5%	51.3%	Profit Before Income Taxes/Net Worth (Per Cent)	14.9%	22.8%	27.8%
7.3%	13.6%	18.8%	Profit Before Income Taxes/Assets	6.3%	12.5%	19.0%

*Less or More than Median Profits before Taxes of 7.1%
**Less or More than Median Profits before Taxes of 7.3%

Source: SPI Financial & Operating Ratios Survey #18

CUSTOM PROCESSORS BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION			Operating Statements	SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*		Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.5	0.6	0.7	Freight Out & Warehousing	1.1	1.0	0.8
2.0	2.0	1.9	Direct Packaging & Shipping Supplies	2.8	2.2	1.6
36.0	35.9	35.8	Direct Materials	46.9	45.6	44.3
16.3	15.6	14.6	Direct Labor	10.4	11.2	12.0
8.6	8.9	9.2	Indirect Labor	9.2	7.8	6.3
3.3	3.1	2.9	Utilities	2.8	2.6	2.4
7.1	6.3	4.9	Other Variable Mfg. Expense	4.9	5.0	5.0
3.1	2.9	2.6	Depreciation Expense	3.3	2.8	2.3
1.5	1.4	1.4	Lease Expense	0.8	0.7	0.7
1.8	1.8	1.8	Other Fixed Mfg. Expense	1.4	1.4	1.4
1.0	0.3	(0.4)	Net on Tool Transactions	(0.3)	0.2	0.6
1.7	1.4	1.0	Sales Commissions	1.0	1.5	2.0
2.2	2.4	2.6	Other Sales Expense	2.5	2.4	2.4
10.4	9.7	8.0	Administrative Expense	8.3	7.4	6.3
4.5	7.7	13.0	Operating Earnings	4.9	8.2	11.9
N.A.	1.2	2.4	Engineering Expense	1.1	1.6	2.2
2.5	1.8	1.0	Research & Development Expense	0.5	0.7	1.0
1.3	1.0	0.7	Interest	2.0	1.2	0.3
0.6	0.3	0.1	Misc. (Income) or Expense	(0.1)	0.0	0.1
0.1	3.4	8.8	Profit Before Income Taxes	1.4	4.7	8.3
(0.1)	0.9	2.2	Federal Income Tax	0.5	1.9	3.4
0.1	0.3	0.6	Other Income Taxes	0.2	0.3	0.6
0.1	2.2	6.0	PROFIT AFTER INCOME TAXES	0.7	2.5	4.3
205.8%	194.6%	183.3%	Sales as Percentage of Total Assets	186.5%	183.4%	180.3%
			Balance Sheets			
2.7	3.7	4.7	Cash & Equivalents	1.3	4.1	6.9
26.3	27.3	28.3	Accounts & Notes Receivable	23.9	25.6	27.3
11.3	11.3	11.3	Raw Material Inventory	9.7	9.8	9.8
9.8	8.2	6.5	Work in Process Inventory	3.7	3.8	4.0
5.8	5.2	4.6	Finished Goods Inventory	5.8	8.6	11.3
3.4	3.0	2.7	LIFO Reserve	3.2	4.8	6.5
1.1	0.9	0.7	Packaging & Shipping Supplies	1.2	1.1	1.0
3.1	2.4	1.8	Other Current Assets	1.6	1.5	1.4
56.7	56.0	55.2	CURRENT ASSETS	44.0	49.7	55.2
13.1	19.5	25.8	Land & Buildings, at Cost	23.5	23.4	23.3
5.0	5.3	5.5	Depreciation Reserve	6.8	6.6	6.4
64.7	56.5	49.2	Machinery & Equipment, at Cost	58.1	54.4	50.7
32.8	30.6	29.0	Depreciation Reserve	25.1	27.5	29.8
4.5	3.3	2.1	Molds, Tools, & Dies, at Cost	3.2	3.3	3.4
3.6	2.3	1.1	Depreciation Reserve	1.7	2.4	3.1
2.4	2.9	3.3	Other Long-Term Assets	4.8	5.7	6.7
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
3.3	3.2	3.0	Current Portion of Term Debt	3.0	2.2	1.4
16.4	13.6	10.9	Notes Payable	16.2	10.7	5.2
12.8	11.6	10.3	Accounts Payable, Trade	14.2	12.6	10.9
5.9	5.9	5.9	Other Payables & Accruals	4.3	5.4	6.6
2.2	1.9	1.6	Provision for Income Taxes	1.4	2.4	3.4
40.6	36.2	31.7	CURRENT LIABILITIES	39.1	33.3	27.5
9.1	10.2	11.4	Real Estate Mortgages	8.7	7.6	6.5
7.4	7.9	8.4	Other Long-Term Debt	18.8	14.1	9.4
57.1	54.3	51.5	TOTAL LIABILITIES	66.6	55.0	43.4
42.9	45.7	48.5	EQUITY (NET WORTH)	33.4	45.0	56.6
			Statistical Data			
$43,934	$43,672	$43,409	Net Sales/Number of All Employees	$54,828	$56,007	$57,185
50.0%	46.5%	43.0%	Prod. Man Hrs./Available Mach. Hrs.	53.3%	50.0%	46.7%
$22.95	$23.40	$23.84	Net Sales/All Employees Man Hours	$29.62	$28.19	$26.75
210.8%	220.9%	231.0%	Net Sales/Total Employment Costs	325.5%	325.0%	324.5%
$31.53	$33.81	$36.08	Net Sales/Production Worker Man Hrs.	$42.40	$42.76	$43.12
390.0%	369.2%	348.3%	Net Sales/Prod. Worker Emp. Costs	569.6%	544.3%	519.0%
$1.17	$1.41	$1.65	Net Sales—Cost of Matls./lbs. Proc.	$.74	$.90	$1.06
$.45	$.46	$.46	Total Mfg. Payroll/lbs. Processed	$.19	$.24	$.28
2.9%	8.5%	14.0%	Percent Change in Sales, '80 vs '79	1.5%	4.9%	8.2%
52.0	51.8	51.8	Cost of Sales/Inventory (Days)	37.5	43.1	49.0
46.6	51.2	56.4	Average Collection Period (Days)	46.8	50.9	55.3
0.2%	6.6%	16.1%	Profit Before Income Taxes/Assets	2.6%	8.6%	15.0%
1.4%	4.7%	11.7%	Profit Before Income Taxes/Gross Assets	1.9%	6.1%	10.3%
5.5%	7.9%	11.9%	Cash Return/Gross Assets	6.2%	7.7%	8.1%
0.5%	9.4%	22.7%	Net Income/Equity	3.9%	10.2%	13.7%
2.5%	1.8%	1.0%	Research & Development Expense/Net Sales	0.5%	0.7%	1.0%

*Less or More than Median Profits before Taxes of 0.0%

**Less or More than Median Profits before Taxes of 0.0%

Source: SPI Financial & Operating Ratios Survey #19

CUSTOM PROCESSORS BY SALES GROUPS —1979

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	Operating Statements	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.5	0.3	0.2	Freight Out & Warehousing	2.0	1.2	1.1
38.6	38.4	36.9	Direct Materials	44.5	43.6	42.6
18.8	16.4	15.2	Direct Labor	13.1	12.5	11.8
10.4	9.8	9.3	Indirect Labor	9.4	8.5	8.0
3.3	3.0	2.6	Utilities	3.0	3.0	2.9
7.1	7.1	7.0	Other Variable Mfg. Expense	8.1	7.6	4.9
2.8	2.8	2.8	Depreciation & Lease Payments	3.4	3.1	2.9
2.6	2.6	2.6	Other Fixed Mfg. Expense	1.6	2.0	3.5
0.3	0.8	1.3	Net on Tool Transactions	0.1	0.1	0.1
1.5	1.3	1.0	Sales Commissions	2.0	1.7	1.1
2.8	2.7	2.6	Other Sales Expense	2.9	2.9	2.8
10.0	9.5	8.2	Administrative Expense	6.3	6.0	5.9
1.2	1.0	0.8	Interest	1.5	1.5	1.4
(.1)	0.1	0.3	Misc. Income or (Expense)	0.3	0.3	0.3
0.2	4.2	9.2	Profit Before Income Taxes	1.8	6.0	10.7
(1.3)	0.8	2.4	Federal Income Tax	0.2	2.1	4.1
0.1	0.1	0.1	Other Income Taxes	0.1	0.3	0.4
1.4	3.3	6.7	PROFIT AFTER INCOME TAXES	1.5	3.6	6.2
213.1%	201.0%	175.0%	Sales as Percentage of Total Assets	156.0%	180.8%	204.0%
			Balance Sheets			
3.3	6.4	8.5	Cash & Equivalents	4.1	2.8	2.6
25.1	29.7	31.2	Accounts & Notes Receivable	24.6	23.3	21.4
8.5	10.7	11.3	Raw Material Inventory	9.4	9.0	8.4
6.5	3.9	2.9	Work in Process Inventory	4.0	4.1	4.1
4.3	4.4	4.5	Finished Goods Inventory	4.3	7.5	8.2
3.2	2.7	2.4	Other Current Assets	2.3	2.0	1.6
50.9	57.8	60.8	CURRENT ASSETS	48.7	48.7	46.3
18.4	17.8	17.3	Land & Buildings, at Cost	25.7	24.7	24.0
5.7	5.0	3.9	Depreciation Reserve	7.4	6.7	5.1
64.7	55.8	47.1	Machinery & Equipment, at Cost	53.2	54.6	57.5
33.4	29.9	24.0	Depreciation Reserve	24.5	25.2	26.1
2.6	2.6	2.6	Molds, Tools, & Ties, at Cost	4.6	3.6	2.9
2.5	1.9	1.8	Depreciation Reserve	3.5	2.9	2.7
5.0	2.8	1.9	Other Long-Term Assets	3.2	3.2	3.2
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
5.2	5.2	5.2	Current Portion of Term Debt	5.0	3.2	1.6
9.9	9.7	9.5	Notes Payable	9.4	7.1	3.7
15.6	13.5	10.3	Accounts Payable, Trade	13.9	10.3	8.7
7.7	7.6	7.5	Other Payables & Accruals	4.9	4.8	4.7
1.0	1.7	2.8	Provision for Income Taxes	1.5	2.0	3.6
39.4	37.7	35.3	CURRENT LIABILITIES	34.7	27.4	22.3
9.3	4.0	3.0	Real Estate Mortgages	7.0	7.8	8.0
13.4	14.0	17.1	Other Long-Term Debt	16.9	13.2	9.2
62.1	55.7	55.4	TOTAL LIABILITIES	58.6	48.4	39.5
37.9	44.3	44.6	EQUITY (NET WORTH)	41.4	51.6	60.5
			Statistical Data			
$33,434	$35,097	$37,155	Net Sales/Number of All Employees	$43,000	$44,651	$46,095
72.5%	80.2%	85.0%	Prod. Man Hrs./Available Mach. Hrs.	97.7%	90.2%	84.6%
$17.58	$17.50	$17.41	Net Sales/All Employees Man Hours	$23.52	$23.83	$24.08
236.0%	242.3%	246.8%	Net Sales/Total Employment Costs	276.7%	341.5%	379.8%
$21.60	$20.32	$19.51	Net Sales/Production Worker Man Hrs.	$32.00	$33.84	$35.45
21.0%	204.6%	235.1%	Net Sales/Prod. Worker Emp. Costs	480.8%	511.1%	537.0%
$.98	$1.17	$1.30	Net Sales—Cost of Matls./lbs. Proc.	$.81	$.76	$.67
$.40	$.43	$.46	Total Mfg. Payroll/lbs. Processed	$.22	$.23	$.25
12.4%	12.3%	12.2%	Percent Change in Sales, '78 vs '77	14.2%	13.3%	12.5%
39.2	42.5	50.1	Cost of Sales/Inventory (Days)	48.6	51.0	53.2
43.0	53.9	65.1	Average Collection Period (Days)	57.6	47.0	38.3
1.1%	19.1%	36.1%	Profit Before Income Taxes/Net Worth (Per Cent)	6.8%	21.0%	36.1%
4.3%	8.4%	16.1%	Profit Before Income Taxes/Assets	2.8%	10.8%	21.8%

*Less or More than Median Profits before Taxes of 4.2%

**Less or More than Median Profits before Taxes of 6.0%

Source: SPI Financial & Operating Ratios Survey #18

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION			Operating Statements	SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*		Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.6	0.6	0.6	Freight Out & Warehousing	1.5	1.3	1.0
2.0	2.0	1.8	Direct Packaging & Shipping Supplies	2.8	2.2	1.7
38.5	37.6	35.7	Direct Materials	46.6	45.1	43.4
16.3	15.3	14.3	Direct Labor	10.8	11.2	11.6
8.5	8.9	9.1	Indirect Labor	9.2	7.9	6.6
3.1	2.9	2.6	Utilities	2.7	2.6	2.4
5.4	5.1	4.8	Other Variable Mfg. Expense	5.2	5.0	4.8
3.2	2.9	2.6	Depreciation Expense	3.2	2.8	2.5
1.5	1.4	1.1	Lease Expense	0.7	0.8	0.9
1.8	1.9	1.9	Other Fixed Mfg. Expense	1.4	1.5	1.5
1.0	0.6	(.1)	Net on Tool Transactions	(0.3)	0.2	0.6
1.7	1.5	1.3	Sales Commissions	1.2	1.6	2.1
2.6	2.8	2.9	Other Sales Expense	3.2	3.2	3.2
9.3	8.8	7.9	Administrative Expense	6.9	6.6	6.3
6.0	7.7	13.5	Operating Earnings	4.9	8.1	11.4
N.A.	1.2	2.4	Engineering Expense	1.1	1.3	1.5
2.5	1.9	1.2	Research & Development Expense	0.5	0.6	1.0
1.3	1.0	0.7	Interest	2.0	1.2	0.5
0.6	0.4	0.2	Misc. (Income) or Expense	(0.1)	0.1	0.1
0.1	3.2	9.0	Profit Before Income Taxes	1.4	4.8	8.3
(.1)	1.1	3.4	Federal Income Tax	0.5	1.9	3.4
.1	0.3	0.6	Other Income Taxes	0.1	0.3	0.6
0.1	1.8	5.0	PROFIT AFTER INCOME TAXES	0.8	2.6	4.3
184.7%	172.9%	161.1%	Sales as Percentage of Total Assets	184.2%	178.3%	172.4%
			Balance Sheets			
2.5	3.6	4.6	Cash & Equivalents	1.2	2.8	4.6
25.2	26.3	28.3	Accounts & Notes Receivable	23.6	25.1	26.7
10.9	11.1	11.3	Raw Material Inventory	9.5	8.7	8.0
10.3	7.0	3.5	Work in Process Inventory	3.7	3.5	3.1
4.5	5.2	5.4	Finished Goods Inventory	8.6	10.7	12.7
3.4	3.0	2.5	LIFO Reserve	5.0	5.7	6.5
0.8	0.7	0.7	Packaging & Shipping Supplies	1.2	1.1	1.0
2.9	2.4	1.8	Other Current Assets	2.4	2.1	1.8
53.7	53.3	53.1	CURRENT ASSETS	45.2	48.3	51.4
18.9	22.3	25.6	Land & Buildings, at Cost	23.7	23.2	22.6
4.7	5.5	6.2	Depreciation Reserve	6.9	6.7	6.6
58.7	53.4	49.0	Machinery & Equipment, at Cost	55.3	52.1	48.9
30.1	27.1	25.2	Depreciation Reserve	25.0	23.3	21.6
4.8	3.8	2.8	Molds, Tools, & Dies, at Cost	4.9	5.7	6.5
3.9	3.1	2.3	Depreciation Reserve	2.5	4.2	5.8
2.6	2.9	3.2	Other Long-Term Assets	5.3	4.9	4.6
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
3.0	2.8	2.6	Current Portion of Term Debt	3.0	2.3	1.5
16.3	12.7	9.2	Notes Payable	18.4	10.9	3.5
12.8	11.5	10.3	Accounts Payable, Trade	11.0	10.8	10.6
6.0	5.9	5.8	Other Payables & Accruals	5.1	5.8	6.5
0.1	1.9	3.5	Provision for Income Taxes	1.4	2.5	3.5
38.2	34.8	31.4	CURRENT LIABILITIES	38.9	32.3	25.6
14.3	13.0	11.7	Real Estate Mortgages	8.5	8.8	9.1
7.3	7.9	8.4	Other Long-Term Debt	18.7	14.3	10.0
59.8	55.7	51.5	TOTAL LIABILITIES	66.1	55.4	44.7
40.2	44.3	48.5	EQUITY (NET WORTH)	33.9	44.6	55.3
			Statistical Data			
$45,160	$44,930	$44,700	Net Sales/Number of All Employees	$54,914	$57,275	$59,635
50.0%	46.3%	42.5%	Prod. Man Hrs./Available Mach. Hrs.	53.3%	54.9%	56.5%
$24.62	$24.55	$24.47	Net Sales/All Employees Man Hours	$29.69	$29.17	$28.65
210.8%	224.2%	237.6%	Net Sales/Total Employment Costs	316.0%	322.6%	329.1%
$31.25	$34.15	$37.05	Net Sales/Production Worker Man Hrs.	$42.83	$43.91	$44.98
411.0%	387.9%	364.7%	Net Sales/Prod. Worker Emp. Costs	534.5%	528.3%	522.1%
$.95	$1.13	$1.30	Net Sales—Cost of Matls./lbs. Proc.	$.74	$.90	$1.06
$.36	$.33	$.30	Total Mfg. Payroll/lbs. Processed	$.19	$.23	$.27
4.5%	7.3%	10.0%	Percent Change in Sales, '80 vs '79	7.4%	8.2%	9.0%
54.5	54.5	53.8	Cost of Sales/Inventory (Days)	39.6	44.3	47.9
49.8	55.3	64.1	Average Collection Period (Days)	46.8	51.4	56.5
0.2%	5.5%	14.5%	Profit Before Income Taxes/Assets	2.6%	8.6%	14.3%
0.1%	3.9%	10.6%	Profit Before Income Taxes/Gross Assets	1.8%	6.1%	10.2%
5.1%	8.2%	9.4%	Cash Return/Gross Assets	7.4%	7.6%	9.3%
4.6%	7.0%	16.6%	Net Income/Equity	4.3%	10.4%	13.4%
2.5%	1.9%	1.2%	Research & Development Expense/Net Sales	0.5%	0.6%	1.0%

*Less or More than Median Profits before Taxes of 0.0%

**Less or More than Median Profits before Taxes of 0.0%

Source: SPI Financial & Operating Ratios Survey #19

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS – 1979

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	**Operating Statements**	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.6	0.3	0.3	Freight Out & Warehousing	2.4	1.9	1.8
38.8	38.5	36.4	Direct Materials	44.7	43.5	41.4
17.1	15.4	14.9	Direct Labor	12.9	11.9	11.3
10.4	9.0	8.7	Indirect Labor	8.7	7.8	7.6
3.1	3.0	2.3	Utilities	3.0	2.9	2.7
6.6	7.4	8.4	Other Variable Mfg. Expense	6.4	6.0	4.8
3.8	3.3	3.3	Depreciation & Lease Payments	3.4	3.2	2.9
2.6	2.6	1.9	Other Fixed Mfg. Expense	1.8	2.1	2.5
0.3	0.8	0.9	Net on Tool Transactions	0.1	0.1	0.1
1.3	1.2	1.1	Sales Commissions	2.2	1.9	1.7
2.7	2.9	2.9	Other Sales Expense	3.0	4.1	5.1
9.9	9.4	7.7	Administrative Expense	6.3	5.9	5.9
1.1	1.3	1.4	Interest	1.5	1.4	1.2
(.1)	0.1	0.3	Misc. Income or (Expense)	0.3	0.3	0.3
1.8	4.8	9.5	Profit Before Income Taxes	3.3	7.0	10.7
(.5)	0.7	2.5	Federal Income Tax	1.0	2.3	4.1
0.1	0.1	0.1	Other Income Taxes	0.3	0.4	0.4
2.2	4.0	6.9	PROFIT AFTER INCOME TAXES	2.0	4.3	6.2
208.7%	192.0%	180.1%	Sales as Percentage of Total Assets	164.7%	178.0%	180.1%
			Balance Sheets			
4.6	5.0	5.0	Cash & Equivalents	3.9	2.2	1.7
28.1	30.3	32.2	Accounts & Notes Receivable	24.2	23.7	21.9
8.9	9.6	10.9	Raw Material Inventory	8.7	8.7	8.7
3.9	4.3	4.4	Work in Process Inventory	4.0	4.1	4.1
4.3	4.4	6.2	Finished Goods Inventory	8.5	8.7	8.7
3.9	2.6	2.3	Other Current Assets	2.0	2.0	2.0
53.7	56.8	61.0	CURRENT ASSETS	51.3	49.4	47.1
18.8	19.7	19.8	Land & Buildings, at Cost	24.2	23.9	22.9
5.7	5.0	3.8	Depreciation Reserve	6.7	5.7	5.2
60.1	50.6	42.9	Machinery & Equipment, at Cost	53.7	54.5	56.5
31.3	25.4	24.1	Depreciation Reserve	26.3	27.0	27.0
2.7	3.6	4.6	Molds, Tools, & Ties, at Cost	4.9	4.9	4.9
2.6	2.2	2.2	Depreciation Reserve	3.5	3.2	2.9
4.5	2.9	1.8	Other Long-Term Assets	2.4	3.2	3.7
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
5.1	4.3	4.2	Current Portion of Term Debt	4.6	2.9	1.4
10.0	9.8	9.6	Notes Payable	8.3	5.1	3.7
15.2	13.6	11.3	Accounts Payable, Trade	12.4	10.5	8.7
7.5	7.5	7.2	Other Payables & Accruals	5.1	4.9	4.9
1.2	2.5	3.4	Provision for Income Taxes	2.1	2.8	3.6
39.0	37.7	35.7	CURRENT LIABILITIES	32.5	26.2	22.3
8.5	5.3	5.1	Real Estate Mortgages	11.3	6.7	4.1
10.9	14.0	15.9	Other Long-Term Debt	14.7	13.7	9.1
58.4	56.8	56.7	TOTAL LIABILITIES	58.5	46.6	35.5
41.6	43.2	43.3	EQUITY (NET WORTH)	41.5	53.4	64.5
			Statistical Data			
$33,812	$35,427	$37,496	Net Sales/Number of All Employees	$46,364	$46,920	$48,417
72.5%	79.4%	86.3%	Prod. Man Hrs./Available Mach. Hrs.	170.8%	134.6%	82.0%
$17.62	$18.14	$19.00	Net Sales/All Employees Man Hours	$25.76	$25.12	$24.08
236.0%	229.4%	225.0%	Net Sales/Total Employment Costs	324.1%	342.7%	370.1%
$21.60	$25.89	$29.05	Net Sales/Production Worker Man Hrs.	$39.00	$36.54	$34.98
273.7%	299.7%	345.6%	Net Sales/Prod. Worker Emp. Costs	508.8%	511.3%	520.6%
$.98	$1.07	$1.18	Net Sales—Cost of Matls./lbs. Proc.	$.82	$.89	$.96
$.43	$.42	$.41	Total Mfg. Payroll/lbs. Processed	$.20	$.23	$.28
10.5%	13.2%	13.7%	Percent Change in Sales, '78 vs '77	12.7%	14.2%	19.8%
35.9	43.4	56.4	Cost of Sales/Inventory (Days)	56.3	55.5	58.0
49.1	58.2	65.3	Average Collection Period (Days)	53.1	48.6	44.4
9.0%	21.3%	41.2%	Profit Before Income Taxes/Net Worth (Per Cent)	13.2%	22.5%	29.7%
3.8%	9.2%	17.2%	Profit Before Income Taxes/Assets	5.4%	12.5%	19.3%

*Less or More than Median Profits before Taxes of 4.8%
**Less or More than Median Profits before Taxes of 7.0%

Source: SPI Financial & Operating Ratios Survey #18

"Almost anything you can make out of anything, you can make with less energy from plastics."

Courtesy: Gulf Oil Corporation

ENERGY, FEEDSTOCKS, & ADDITIVES

PLASTICS: THE ENERGY SAVER[1]

In a study prepared by Franklin Associates, Ltd. the use of plastics products and equivalent products made from non-plastics alternative materials was analyzed in terms of energy impact. The 1981 study concluded that energy consumption would increase substantially if plastics products were not available.

The results of the study are presented in terms of net energy savings. These savings are the difference between the quantity of energy consumed in the manufacture of plastics products and that of non-plastics alternative products. Energy values are given in British Thermal Units (Btu) and because of the large quantities of materials and related consumption, all energy is stated in trillion (10^{12}) Btu. For comparison, the energy content of a barrel of oil is 5.8 million Btu and of one ton of coal is 29.2 million Btu. The following summary findings are noted:

- For most end-uses, plastics products require less energy to manufacture and use than equivalent products made of alternative materials.

- In the analyses of specific resins or groups of resins, the sum of the energy required for the plastics products was always less than that required for the products made of alternative materials. In other words, when entire resins or groups of similar resins are examined for all end-uses, the energy requirements for using those resins are less than the requirements for using alternative non-plastics products.

- In 1978, if the plastics products analyzed in this study had been completely replaced by the selected non-plastics alternative products, total energy consumption would have increased by 834.2 trillion Btu.

- Although market conditions and manufacturing technologies continue to change, it is reasonable to expect the same relative energy savings from the use of plastics over non-plastics materials in future years.

- The total energy savings determined in this study are associated with the manufacture and use of 82 percent of the plastics consumed in the U.S. in 1978. It is believed that the plastics resins not included in this study would show energy savings through the use of plastics. However, the results of the study should not be extrapolated to total resin use.

- Plastics products require less energy than non-plastics products in 204 of the 264 markets studied. These 204 markets account for 90 percent of the resins analyzed. Of the 55 markets showing higher energy consumption for the plastics products, 12 showed a difference of less than 10 percent.

- To illustrate the magnitude of energy savings through plastics, 834 trillion Btu is equivalent to:

  - 75,766 million kilowatt-hours

  or

  - 28.7 million tons of coal

  or

  - 142 million barrels of oil

  or

  - 2,484 million gallons of gasoline

[1]Both the Summary and complete Franklin study are available from the Literature Department, SPI, 355 Lexington Ave., N.Y., N.Y. 10017.

Energy savings by resin, 1978

Resin	Total Energy Savings Trillion (10^{12}) Btu
High density polyethylene	159.5
Polystyrene	151.4
PVC	139.9
Polypropylene	123.0
Low density polyethylene	113.9
Polyester	86.6
ABS and SAN	49.8
Nylon	5.4
Phenolics, Urea, and Melamine	4.7
Total resin studied	834.2[1]

[1] With energy savings from wood-derived fuel omitted this figure would be 733.1 trillion Btu.

Summary of energy use by source, 1978

Comparative energy requirements associated with plastics products
Produced from twelve major plastics and
Equivalent products made of alternative materials

Trillion (10^{12}) Btu

Energy Consumption[1]

	Plastics Products[2]	Non-Plastics Alternatives	Energy Savings With Plastics (Net Difference)
Hydrocarbons	970.5	1,124.3	153.8[3]
Coal	153.7	700.7	547.0
Hydropower	13.2	30.3	17.1
Nuclear	30.0	45.2	15.2
Wood	13.9	115.0	101.1
Total	1,181.3	2,015.5	834.2[4,5]

[1] Energy consumption represents the total energy required to manufacture the products produced from the resin included in the analysis and the non-plastics alternatives to those products.

[2] No realistic plastics alternatives were identified for 10.5 percent of the resin included in the comparative energy analysis. The energy required to produce these products is not included here.

[3] Includes an estimated savings of 186.4 trillion Btu for natural gas and an increased consumption of 32.6 trillion Btu for petroleum.

[4] Approximately 5.1 percent of the total estimated savings are calculated using service life analyses for 11 specific markets. These analyses account for the energy used in the service life of the products in addition to the energy of manufacture.

[5] With wood-derived fuel omitted the net difference would be 733.1 trillion Btu.

PLASTICS DERIVED FROM MAJOR FEEDSTOCKS*

(in millions of pounds)

Feedstock	Total Production		Plastics Derivatives		Plastics % of Total	
	1980	1979	1980	1979	1980	1979
Ethylene	27,760	29,190	16,955	18,745	61	64
Propylene	12,260	12,690	5,455	5,965	44	47
Benzene	11,420	12,665	6,125	7,170	54	57

*These data should not be construed to represent the entire feedstock needs of the U.S. plastics industry. They are based on 1979 and 1980 plastics production only and do not include feedstock needs for monomers, additives, and other chemicals not used in domestic production.

PLASTICS CONSUMPTION OF FEEDSTOCKS—1980

(millions of pounds)

ETHYLENE	Styrene Butadiene Latex	150	0.9%
	Styrene Acrylonitrile	25	0.1
	Acrylonitrile Butadiene Styrene	165	1.0
	Polyvinyl acetate	275	1.6
	Polyethylene	12,280	72.4
	Polystyrene	1,185	7.0
	Other Styrenes	45	0.3
	Polyvinyl chloride	2,830	16.7
		16,955	100.0%
PROPYLENE	Epoxy	210	3.9%
	Phenolic	690	12.6
	Polypropylene	4,015	73.6
	Polyester	205	3.8
	Styrene Acrylonitrile	45	0.8
	Acrylonitrile Butadiene Styrene	290	5.3
		5,455	100.0%
BENZENE	Acrylonitrile Butadiene Styrene	450	7.3%
	Styrene Acrylonitrile	75	1.2
	Styrene Butadiene Latex	350	5.7
	Polystyrene	3,210	52.4
	Other Styrene	90	1.5
	Epoxy	195	3.2
	Polyester	215	3.5
	Nylon	390	6.4
	Phenolic	1,150	18.8
		6,125	100.0%

SELECTED PLASTICS PRECURSORS

Precursor	Total Production		Plastics Derivatives		Plastics % of Total	
	1980	1979	1980	1979	1980	1979
Acrylonitrile	1,830	2,020	225	285	12	14
Bisphenol A	525	575	430	490	82	85
Butadiene	2,935	3,550	445	570	15	16
Cyclohexane	1,970	2,410	315	370	16	15
Formaldehyde	5,690	6,450	4,335	5,185	76	80
Maleic Anhydride	300	350	155	190	52	54
Phenol	2,460	2,945	1,800	2,100	73	71
Phthalic Anhydride	855	1,040	485	600	57	58
Styrene	6,900	7,485	4,985	5,785	72	77
Vinyl Acetate	1,920	1,985	1,920	1,985	100	100
Vinyl Chloride	6,470	7,545	6,470	7,545	100	100

Source: U.S. International Trade Commission, SRI International, Society of the Plastics Industry estimates

ADDITIVES FOR PLASTICS

ADDITIVE LUBRICANTS

These materials are added to plastics to assist flow in calendering, molding and extrusion by lubricating the metal surfaces in contact with the plastic. They also assist in knitting and wetting of the resin in mixing and milling operations. To be effective, lubricants must be compatible with the resins in which they are used, must not adversely affect the properties of end-products, and must be easily combined.

Examples: stearic acid, waxes, fatty acid esters, fatty acid amines.

ANTIOXIDANTS

They inhibit the oxidation of materials exposed to air or oxygen at normal or elevated temperatures. They are used in plastics which are subject to oxidative degradation, such as polyolefins, ABS, polystyrene, acetal and polyphenylene oxide.

Examples: alkylated phenols, amines, organic phosphites and phosphates, esters.

ANTISTATS

Chemicals which impart a slight to moderate degree of electrical conductivity to plastics compounds, thus preventing the accumulation of electrostatic charges on finished articles. They may be incorporated in the materials before molding, or applied to their surfaces after molding. They function either by being inherently conductive or by absorbing moisture from the air.

Examples: quaternary ammonium compounds, anionics, amines.

BLOWING AGENTS [FOAMING AGENTS]

Substances which alone or in combination with other substances are capable of producing a cellular structure in a plastic or rubber mass. Thus, the term includes compressed gases which expand when pressure is released, soluble solids that leave pores when leached out, liquids that develop cells when they change to gases, and chemical agents that decompose or react under the influence of heat to form a gas.

Examples: azodicarbonamide, modified azos, OBSH, HTBA.

COLORANTS

Dyes or pigments which impart color to plastics. The dyes are synthetic or natural compounds of submicroscopic or molecular size, soluble in most common solvents, yielding perfectly transparent colors. The pigments are organic and inorganic substances with larger particle sizes and usually insoluble in the common solvents. Colorants are added to plastics by dry coloring (tumbling the colorant with the base or compounded resin); by extrusion coloring (extruding a dry colored mixture and chopping it into pellets to be reprocessed); by masterbatching; or by stirring colorants or dispersions thereof into liquid plastisols or resin systems.

Examples: titanium dioxide, iron oxides, anthraquinones, carbon black.

FLAME RETARDANTS

Materials that reduce the tendency of plastic articles to burn. They are usually incorporated as additives during compounding, but sometimes are applied to surfaces of finished articles.

Examples: antimony trioxide, chlorinated paraffins, bromophenols.

HEAT STABILIZERS

Agents used in compounding some plastics to assist in maintaining the physical and chemical properties of the compounded materials at suitable values throughout the processing and service life of the material and/or the parts made therefrom. They protect plastics from the effects of heat such as changes in color, decrease in mechanical and electrical properties, and undesirable surface conditions.

Examples: lead, barium-cadmium, tin, calcium-zinc.

ORGANIC PEROXIDES

Thermally decomposable compounds which can initiate polymerization reactions and effect cross-linking upon decomposition. The rate of decomposition can be controlled by means of promoters or accelerators added to the system to increase the decomposition rate; or by inhibitors when it is desired to retard the decomposition.

Examples: MEK peroxide, benzoyl peroxide, alkyl peroxide, peresters.

PLASTICIZERS

Materials incorporated in a plastic or elastomer to increase its flexibility, workability or distensibility. Most plasticizers are nonvolatile organic liquids or low-melting point solids, which function by reducing the normal intermolecular forces in a resin thus permitting the macromolecules to slide over one another more freely.

Examples: adipates, azelates, trimellitates, DOP/DIOP/DIDP.

ULTRAVIOLET STABILIZERS (UV LIGHT ABSORBERS)

Chemical agents which absorb or screen out radiation beyond the violet end of the spectrum of visible radiations. Such radiation has sufficient energy to initiate reactions leading to the degradation of many plastics. These agents are often combined with other additives, e.g. heat stabilizers and antioxidants, with which they act in synergistic fashion.

Examples: benzophenones, benzotriazole, salicylates.

Source: Whittington's Dictionary of Plastics

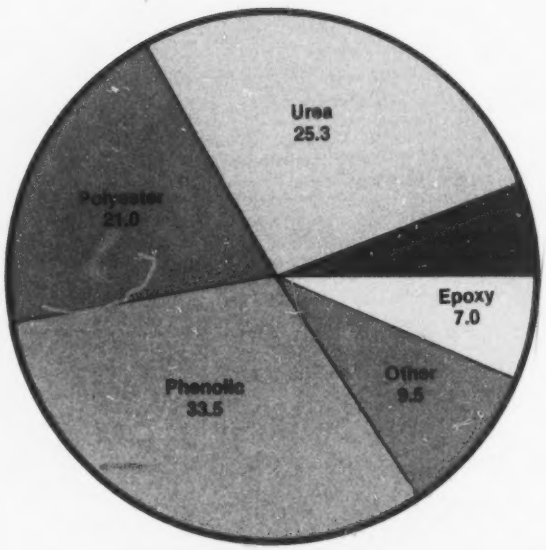
CONSUMPTION OF ADDITIVES
(millions of pounds)

Type	1976	1977	1978	1979r	1980
Additive Lubricants	64	73	78	104	75
Antioxidants	32	34	35	36	32
Antistats	4	4	5	5	5
Blowing Agents	13	14	15	16	15
Colorants	296	304	320	342	310
Flame Retardants	354	396	453	451	475
Heat Stabilizers	85	92	88r	92	83
Organic Peroxides	26	29	32	39	38
Plasticizers	1,646	1,782	1,615	1,654	1,485
Ultraviolet Stabilizers	4	4	4	5	5

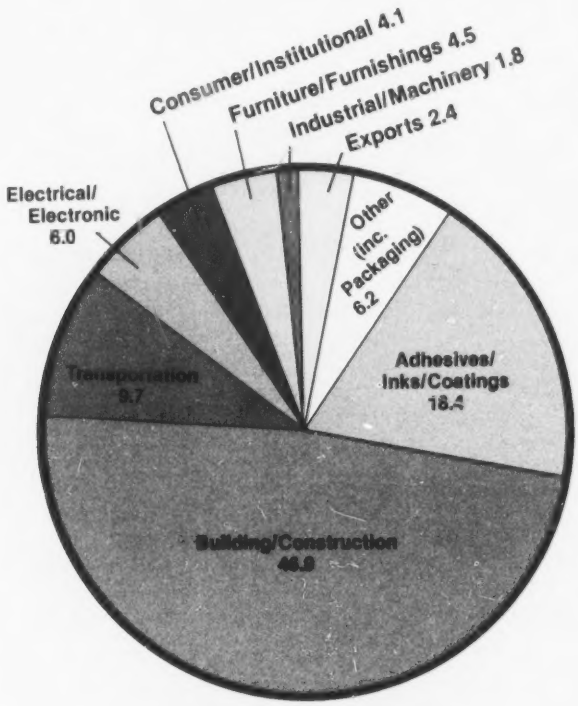
Source: Modern Plastics Magazine
r = revised from 1980 edition

THERMOSETTING RESINS

Plastics which in their final state as finished articles are substantially infusible and insoluble. They are often liquids at some state of their manufacture or processing, which are cured by heat, catalysts or other chemical means. After being fully cured, thermosets cannot be resoftened by heat.



1980 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MATERIAL



1980 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MAJOR MARKET

EPOXY

Manufacturers*

Celanese Plastics & Specialties Co.
Ciba-Geigy Corp.
Dow Chemical U.S.A.
Morton Industries
Reichhold Chemicals
Shell Chemical Co.
Union Carbide Corp.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1980.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1976	244	250
1977	261	278
1978	299	316
1979	361	332
1980	315	319
Compound Growth Rate		
1975-1980	9.7%	11.3%

Percent of Total U.S. Sales & Captive Use	
1976	0.93
1977	0.89
1978	0.90
1979	0.86
1980	0.91

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Bonding & adhesives	19	19	18	17	18
Flooring, paving and aggregates	10	15	17	20	19
Protective coatings	112	126	142	146	137
Fiber reinforced laminates & composites	36	44	54	60	63
Tooling, casting, and molding resins	21	23	31	31	26
All other uses	27	22	23	22	20
Total	225	249	285	296	283

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1978	1979	1980
Transportation	*	*	*
Packaging	*	*	*
Building/Construction	34	28	48
Electrical/Electronic	50	66	55
Furniture/Furnishings	—	—	—
Consumer & Institutional	—	*	—
Industrial/Machinery	*	*	—
Adhesives, Inks & Coatings	153	159	150
All Other	48	43	30
Exports	31	36	36
Total	316	332	319

*Included in All Other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

PHENOLIC

Manufacturers*

Acme Resins Co.
Ametek, Haveg Div.
Ashland Chemical Co.
Bendix Corp.
Borden Chemical Co., Inc.
Cargill, Inc.
Cascade Resins, Inc.
Chembond Corp.
Clark Chemical Corp.
Formica Corp.
General Electric Co.
Georgia-Pacific Corp.
Gulf Oil Chemicals Co.
Haveg Industries, Inc.
Hooker Chemicals & Plastics Corp.
Inland Steel Container Co.
Inmont Corp.
Ironsides Resins, Inc.
Kesco Co.
Koppers Co.
Masonite Corp.
Monsanto Co.
Owens-Corning Fiberglas Corp.
Pacific Resins & Chemicals, Inc.
Pioneer Plastics Corp.
Plaslok Corp.
Plastics Engineering Co.
Polymer Applications Inc.
Polyrez Co., Inc.
Raybestos-Manhattan Corp.
Reichhold Chemicals, Inc.
Rogers Corp.
Rohm and Haas Co.
Schenectady Chemicals, Inc.
Union Carbide Corp.
Uniroyal Chemical Div. Uniroyal, Inc.
Valite Div. Valentine Sugars, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1980.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1976	1,340	1,305
1977	1,458	1,400
1978	1,827	1,788
1979	1,781	1,732
1980	1,499	1,517
Compound Growth Rate		
1975-1980	7.4%	8.0%

	Percent of Total U.S. Sales & Captive Use
1976	4.84
1977	4.50
1978	5.10
1979	4.47
1980	4.31

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978[r]	1979	1980
Molding Compounds	340	328	334	310	246
Bonding & adhesive resins for:					
Laminating	91	92	114	109	97
Coated & bonded abrasives	33	37	40	40	34
Friction materials	29	36	40	39	35
Insulation materials	203	236	279	287	271
Foundry & shell molding	69	79	111	113	80
Plywood	303	326	535	511	445
Fibrous & granulated wood	67	76	123	119	88
Resins sold to Rubber Industry	16	22	25	23	28
All other	53	45	59	57	74
Protective coatings	20	21	23	21	24
All other uses	59	84	79	73	72
Total	1,283	1,382	1,762	1,702	1,494

r = revised from 1980 edition
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	145	182	199	171	135
Packaging	16	18	11	11	10
Building/Construction	616	693	813	940	858
Electrical/Electronic	228	214	184	213	181
Furniture/Furnishings	24	22	18	7	11
Consumer & Institutional	*	*	48	40	33
Industrial/Machinery	*	*	24	21	21
Adhesives, Inks & Coatings	145	130	141	222	186
All Other	109	123	80	77	59
Exports	22	18	25	30	23
Total	1,305	1,400	1,543	1,732	1,517

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UNSATURATED POLYESTER

Manufacturers*

Advance Coatings Corp.
Alpha Chemical Corp.
Ashland Chemical Co.
AZ Products Co.
Cargill, Inc.
Cook Paint & Varnish Co.
Dow Chemical U.S.A.
Freeman Chemical Corp.
Glidden Coatings & Resin Div. SCM Corp.
ICI Americas, Inc.
Inmont Corp.
Interplastics Corp.
Koppers Co.
Owens-Corning Fiberglas Corp.
Pioneer Plastics Corp.
PPG Industries, Inc.
Reichhold Chemicals, Inc.
Rohm and Haas Co.
Schenectady Chemicals, Inc.
Shell Chemical Co.
Sherwin Williams Co., The
USS Chemicals Co.
Vistron Corp.
Whittaker Coatings & Chemicals Co.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1980.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1976	1,042	959
1977	1,061	1,045
1978	1,209	1,199
1979	1,147	1,152
1980	947	949
Compound Growth Rate		
1975-1980	2.6%	4.2%

Percent of Total U.S. Sales & Captive Use	
1976	3.55
1977	3.36
1978	3.42
1979	2.98
1980	2.70

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MAJOR DOMESTIC MARKETS
(in millions of pounds)

	1976	1977	1978	1979	1980
Domestic Reinforced Plastics, Total	751	824	952	906	739
Marine and marine accessories	198	204	249	227	171
Transportation	103	115	119	105	80
Auto, trucks, buses, etc.	89	98	95	86	63
Other transportation	14	17	24	19	17
Construction	277	306	338	325	287
General construction	107	124	135	122	114
Bathroom components & fixtures, general purpose tanks & pipes	99	101	118	106	79
Corrosion resistant tanks, pipes, etc.	71	81	85	97	94
Electrical generation, transmission and distribution	26	34	30	26	23
Consumer goods	67	67	83	85	66
Major appliances and parts	21	14	15	11	7
Recreational goods, toys, etc.	15	15	19	23	19
Other consumer goods	31	37	49	51	40
Gel coats	32	36	46	37	26
Other reinforced	48	62	87	101	86
Domestic Non-Reinforced Plastics, Total	196	208	232	231	214
Castings	117	130	159	160	144
Furniture	9	10	10	7	6
Imitation (cultured) marble	52	56	60	67	63
Other	56	64	89	86	75
Auto body	42	49	50	45	41
Surface and protective coatings	5	6	6	5	5
Bonding and adhesives	5	6	4	5	5
Other non-reinforced	27	17	13	16	19

Source: Quarterly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	366	398	383	362	261
Packaging	*	*	—	—	*
Building/Construction	326	340	423	434	384
Electrical/Electronic	26	27	37	39	25
Furniture/Furnishings	15	*	24	26	26
Consumer & Institutional	77	71	138	138	100
Industrial/Machinery	*	73	80	88	*
Adhesives, Inks & Coatings	5	12	22	15	10
All Other	132	111	77	36	132
Exports	12	13	15	14	11
Total	959	1,045	1,199	1,152	949

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UREA

Manufacturers*

American Cyanamid Co.
Borden Chemical Co., The
Cargill, Inc.
Celanese Plastics & Specialties Co.
Chembond Corp.
Conchemco, Inc.
Cook Paint & Varnish Co.
Dan River Inc.
Du Pont, E.I. de Nemours & Co.
Georgia-Pacific Corp.
Glidden Coatings & Resins Div. SCM
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Gulf Oil Chemicals Co.
Ironsides Resins, Inc.
Kesco Co.
Koppers Co.
Monsanto Co.
Pacific Resins & Chemicals, Inc.
Pioneer Plastics Corp.
Plaskon Div. Hillside
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Valchem Div. United Merchants
Virginia Chemicals

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1980.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	821	809
1977	963	951
1978	1,122	1,103
1979	1,367	1,355
1980	1,165	1,147
Compound Growth Rate 1975-1980	11.0%	10.9%

Percent of Total U.S. Sales & Captive Use

1976	3.00
1977	3.06
1978	3.15
1979	3.50
1980	3.26

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MELAMINE

Manufacturers*

American Cyanamid Co.
American Hoechst Corp.
Borden Chemical Co., The
Cargill, Inc.
Celanese Plastics & Specialties Co.
Chembond Corp.
Conchemco, Inc.
Cook Paint & Varnish Co.
Dan River Inc.
Du Pont, E.I. de Nemours & Co.
Formica Corp.
General Electric Co.
Glidden Coatings & Resins Div. SCM
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Koppers Co.
Monsanto Co.
Owens-Corning Fiberglas Corp.
Pacific Resins & Chemicals, Inc.
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Rohm and Haas Co.
Valchem Div. United Merchants
Virginia Chemicals

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1980.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	186	182
1977	200	203
1978	202	196
1979	200	192
1980	167	166
Compound Growth Rate 1975-1980	7.7%	7.3%

Percent of Total U.S. Sales & Captive Use

1976	0.67
1977	0.65
1978	0.56
1979	0.50
1980	0.47

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UREA AND MELAMINE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Paper treating & coating resins	54	62	71	76	70
Molding Compounds	—	105	101	104	75
Bonding & adhesive resins for:					
Laminating	31	33	30	29	27
Plywood	70	78	90	86	74
Fibrous & granulated wood	587	693	813	1,029	896
Protective coatings	74	85	93	88	66
All other uses	146	69	77	111	87
Total	962	1,125	1,275	1,523	1,295

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	29	*	25	24	*
Packaging	26	24	25	34	*
Building/Construction	501	583	662	915	833
Electrical/Electronic	*	*	49	52	*
Furniture/Furnishings	*	*	274	206	168
Consumer & Institutional	52	45	45	35	51
Industrial/Machinery	*	*	—	—	*
Adhesives, Inks & Coatings	92	132	125	134	99
All Other	262	341	70	123	144
Exports	30	29	24	24	18
Total	992	1,154	1,299	1,547	1,313

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

MISCELLANEOUS THERMOSETS
(in millions of pounds)

	Production				
Resin	**1975**	**1976**	**1977**	**1978**	**1979**
Alkyds	674	705	753	754	755
Furfuryl-type	8	8	n.a.	17	31
Silicones	n.a.	15	18	16	20
Dicyandiamide	2	2	2	2	2
Other[1]	18	26	91	60	70

	Sales				
Resin	**1975**	**1976**	**1977**	**1978**	**1979**
Alkyds	380	471	434	415	408
Furfuryl-type	n.a.	8	n.a.	16	30
Silicones	n.a.	13	11	11	11
Dicyandiamide	1	2	2	2	2
Other[1]	21	24	70	49	61

n.a. = not available
[1]Includes acetone-formaldehyde, glyoxal-formaldehyde, polybutadiene, and other thermosets.
Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

POLYURETHANE FOAMS

TECHNICAL BACKGROUND

Urethane foams are cellular plastics generally formulated by the reactions of two liquids—a polyol and a polyisocyanate—in the presence of a blowing agent, a catalyst, a surfactant, and perhaps other special additive chemicals such as fire retarding agents. By altering the choice of polyol, the type of isocyanate and other ingredients, substantially different polyurethane foams can be made. Depending on their physical characteristics, these foams are classified as flexible, semi-flexible, or rigid with densities ranging from one to more than 60 pounds per cubic foot. The distinction between rigid and flexible urethane foams is fundamental in that their use and disposal characteristics are very different, as are the problems associated with each. Polyisocyanurate foams are considered to fall into the class of rigid urethane foams, since their physical and mechanical properties are similar but they do have improved thermal and combustibility properties.

Production of *rigid* urethane foam involves metering the resin mix (polyol, surfactant, blowing agent and catalyst) and isocyanate through a high speed mixer. The blended components may be used for bun stock, molding, frothing, spraying or continuous laminating.

Most *flexible* urethane foam is produced in a continuous bun up to 8 feet wide, 45 inches high and cut into any desired length. After curing, the buns are sold to fabricators or cut into various shapes and sizes depending on end use (usually cushioning for furniture, mattresses and bed pillows). Flexible urethane foams can be molded to produce complex shapes without extensive fabrication. Final decision concerning the type and quality of ingredients, including special fire retardants and foam properties to be formulated, are made by the individual foamers, molders and applicators in response to demands of their consumer markets.

Because of the extraordinary variety of formulations possible, urethane foams, both rigid and flexible, can be produced to meet a broad spectrum of properties covering density, load bearing, resiliency, compressive strength, closed cell content, water vapor permeability, water absorption, shear and impact strength, elasticity, heat resistance, thermal conductivity and various combustibility properties. Proper care must be exercised to insure that the formulation is not only functionally and economically efficient, but also safe for the intended use.

USE

Urethanes are essentially a new technology material which, while being similar chemically to many other plastics, have unique use characteristics. They are currently the most efficient insulating material on the market and the most widely used cushioning materials; they perform exceptionally well in buoyancy, as a reinforcement material, as an impact absorber, as a sound absorber, as a protective coating, as an adhesive, as a sealant and as a decorative material. Due to their wealth of functional properties and their high degree of cost competitiveness relative to substitutes, urethanes have experienced broad consumer acceptance and market growth.

USE OF FLEXIBLE FOAM

Flexible foam normally ranges in density from 1 to 3 pounds per cubic foot. It has high resiliency and its shape can be easily altered. It can be cut, molded, laminated or bonded to meet a broad spectrum of product and application requirements.

POLYURETHANE FOAM—DOMESTIC SALES & CAPTIVE USE
(in millions of pounds)

	1976	1977	1978	1979	1980	Compound Growth Rate 1975-1980
Flexible and Semi-Flexible Foam						
Bedding (excluding sofa beds)	136	149	161	152	139	+2.3%
Furniture	385	444	484	461	432	+5.4%
Packaging	27	28	33	31	23	+2.8%
Rug and Underlay	113	146	132	143	161	+15.6%
Textile Laminates	27	28	34	42	38	+11.5%
Transportation	351	383	390	352	242	−3.0%
Miscellaneous	62	62	71	44	58	+3.0%
Scrap	122	152	136	150	80	−5.8%
Total Flexible and Semi-Flexible Foam	1,223	1,392	1,441	1,375	1,173	+3.0%
Rigid Foam						
Appliances	74	81	79	84	69	−0.8%
Building Construction	179	236	283	322	315	+16.6%
Furniture	30	32	33	25	22	−6.6%
Marine Flotation	13	16	18	17	15	+4.6%
Packaging	16	21	24	31	34	+27.5%
Transportation	55	58	58	49	46	−0.8%
Miscellaneous	15	21	25	27	38	+22.1%
Total Rigid Foam	382	465	520	555	539	+10.1%
Grand Total Foam	1,605	1,857	1,961	1,930	1,712	+5.0%

Source: Polyurethane Foam End-use Survey,
SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

In Furniture—For furniture use, flexible foam is generally produced in slab form and then cut into cushioning for sofas and chairs. The cushioning market is now dominated by flexible urethane foam. In addition to ease of production, its benefits include relatively uncomplicated fabrication, good load bearing characteristics, and comparatively low cost. High resilience foam molding is a growing segment for furniture consumption due to its ability to produce custom contoured pieces in volume. Cold-curing reduces the need for special oven cures and time-consuming cooling cycles. The finished product also has better seating characteristics than hot molded foam.

Integral skin (self-skinning) flexible foam has properties which compare favorably with its conventional alternative (molded foam covered with vinyl sheet). Due to its excellent flow characteristics, it can be poured into very complex closed molds for a variety of shapes. It can be produced in soft grades for seating or in firm grades for automotive soft-trim parts.

In Transportation—The second largest market for flexible urethane foam is in the transportation industry. In 1970, approximately 19 pounds of foam were used in the average passenger car. By 1979 this had increased to approximately 45 pounds per car. Most of this flexible foam is used in connection with providing comfort and safety. Since September 1, 1972, foams used in this application have been subject to Federal Motor Vehical Safety Standard No. 302—Flammability of Interior Materials—Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses.

In the safety area, semi-flexible foam with its low resiliency and high energy absorption properties is used for dash boards, head rests and arm rests. High density or micro cellular foam is also used in car bumpers for its impact resistance. Reticulated polyester urethane foam is being used as a safety measure in gasoline tanks of racing cars. Some manufacturers are experimenting with foam in door panels and roofs to improve impact resistance, to lessen noise and vibration, to insulate in winter and summer, and generally to increase passenger safety. Urethane consumption will be stimulated further by new Federal safety regulations requiring more impact-absorbing material in all new cars.

In Bedding—Relative to its two competitors, latex rubber and inner springs, urethane foam bedding exhibits comparable comfort and lower cost. It weighs 30 per cent less than inner spring mattresses and as much as 50 per cent lower than foamed rubber. It is easy to turn, can be made to a controlled degree of firmness, has excellent chemical resistance, is long-lasting, non-allergenic and sterilizable. The combustibility of the mattress composite is regulated by the Consumer Product Safety Commission Standard FF 4-72—Flammability of Mattresses.

In Apparel/Textiles—Flexible urethane foam can be bonded or laminated to almost any fabric. In the apparel industry, urethane foam is used to bond face fabrics to linings. This provides cost savings by eliminating the need to cut and sew in separate linings. Foam-bonded and foam-laminated fabrics have been accepted by the large home sewing market because they are very easy to work with, can provide warmth without weight, are comfortable and wrinkle resistant, and they retain their shape. This technique is also applied to shoes, drapes, slip covers, sleeping bags, etc.

In Carpets—Urethane foam is used both as separate carpet pads and on foam-backed carpets. Growth opportunities in this market are good: urethane foam is lighter than its competitors while being less expensive and odor free; it has good tensile strength, is both non-allergenic and resistant to deterioration from moisture, insects, etc., and has superior aging characteristics. Foam-backed carpet composites fall under the jurisdiction of Consumer Product Safety Standards FF 1-70 and FF 2-70 for the surface combustibility of carpets and rugs. Other agencies also have regulations of combustibility covering separate carpet pads.

USE OF RIGID URETHANE FOAM

Rigid foam, like flexible, has a wide range of formulations, densities and uses. For most applications, its density ranges from 1 to 3 pounds per cubic foot, but furniture applications may utilize foams with densities up to 45 pcf.

Rigid foam has good dimensional stability both at high and low temperatures, extremely good insulating values, high compressive strength, relatively low water absorption, excellent buoyancy, and can be molded into rather intricate shapes. It is easy to produce, extremely versatile, and relatively inexpensive. It can be produced by spray, pour-in-place, molding, continuous slab or laminating techniques.

In Construction—Rigid foam insulation is durable and competitive in cost, and has extremely low thermal conductivity and water absorption qualities. Relative to its competitors, it saves from 10% to 30% in comparable thicknesses on the cost of heating and cooling those structures which it insulates as well as proportionately decreasing heating and cooling equipment size. This fact becomes increasingly meaningful with the growing use of more expensive electric heat and the growing critical need to conserve the nation's dwindling energy resources.

Since the development of foam systems acceptable to building code officials, their use has been more generally accepted. Foam has been used successfully as sprayed-on insulation for homes and commercial buildings, with proper protection for fire safety, and as insulation for storage tanks. The Urethane Safety Group of SPI recommends covering rigid urethane foam insulation with a suitable flame barrier as soon as possible after installation.

In Refrigeration—Expanding use of frozen foods has contributed to the increased use of rigid foam in the refrigeration industry. Rigid urethane, used primarily in refrigerators and freezers, has the largest share of the appliance insulation market due to its low thermal conductivity, flexibility in application (foamed-in-place, spray or slab) and the strength it provides to the structure when the foam is bonded to the inside and outside panels. Also, relative to its competitors, rigid foam's superior insulating qualities permit thinner wall construction thus allowing in-house appliances substantially more interior refrigerator or freezer space for the same outside dimensions.

Rigid foam is also considered to be the best available insulating material for use in equipment for transporting frozen food. Specifically, in refrigerated rail or highway vehicles, half as much rigid foam is needed to produce the same insulation efficiency as is produced by glass fibers.

In Furniture/Interior Decoration—The potential for rigid foam appears to be unlimited because it can be used both structurally and decoratively in the higher densities (4 to 40 pounds per cubic foot.) It is comparable to or better than other traditional materials considering that: it has uniform reproducible quality, can be mass produced in a variety of densities and textures, and has outstanding impact resistance. It appears in many forms—tables, cabinets, chair shells, picture frames, decorative beams, wall panels, etc. Certain types of rigid foam furniture have been formulated to provide some degree of flame retardant characteristics which make them more readily acceptable among public or private institutions such as schools and hospitals. Programs are underway studying the combustibility characteristics of these types of foams.

In Transportation—Rigid foam is already used as insulation for car air conditioners, in insulating railroad cars and in trailer trucks. With its superior strength to weight properties, rigid foam can eventually be used for a broad array of automobile structural and mechanical parts, including exteriors. Experimental cars have been built which are virtually all urethane. Rigid foam will also be a key safety material due to its very efficient energy absorption characteristics.

In Marine Use—In addition to its insulation benefits, rigid foam has superior buoyancy characteristics. It has been used successfully in marine salvage operations, in life saving gear, in nuclear submarines, rafts, swimming pools, sporting goods and numerous other floating articles.

POLYURETHANE PRODUCTS

In addition to foams, urethane chemicals find their way into a broad range of other polyurethane products. While the foams represent the dominant end-use outlets for chemicals, these other polyurethane products constitute a sizeable marketplace in themselves, and hence are worthy of separate mention.

The three major subcategories within the Polyurethane Product Reporting Program (of SPI) are Castable Types, Millable Gums, and Thermoplastic Types. The Millable Gums quantities are very small, and the Thermoplastic Types are also overshadowed by the Castables.

Within the Castables subcategory, there is a further break-down among Solid Materials, Microcellular Materials, and a catchall covering Adhesives, Sealants and Coatings. These three product/market areas are roughtly comparable in size at present.

During 1980, total domestic sales of Polyurethane Products were of the order of 225 million pounds or roughly 12% of the sales for all urethanes.

The various categories of Polyurethane Products have widely differing properties, end-uses, and growth rates. The Castable/Solid materials represent a well-established product line with a wide spectrum of end-uses which encompass both industrial mechanical and consumer goods. Growth has been modest. In contrast, the Microcellular types represent new products, still in their rapid growth phase. Primary uses to date have been in automotive applications and for shoe soles. The Adhesives, Sealants, and Coatings grouping by and large represents established applications with modest growth. Similarly, Millable Gums are sold into established markets. The final category—Thermoplastic types—present a more complicated picture. The materials have been around for more than ten years and growth of late has been disappointing. Major markets include automotive, industrial uses such as cable jacketing, and molded parts for both industrial and consumer goods. Depending upon application development work and the dymanics of competing products, Thermoplastic Urethanes have the potential for capturing significantly increased volume of business in the years ahead.

PRODUCTION OF POLYURETHANE PRODUCTS
(thousands of pounds)

	1976	1977	1978	1979	1980
Castable Types, Total	168,222	182,923	237,959	269,501	207,095
Solid	53,854	56,409	72,920	83,975	71,771
Microcellular	43,418	53,040	63,394	71,204	63,120
Adhesives, Sealants & Coatings	70,950	73,474	101,645	114,322	72,204
Millable Gum Type	1,086	1,061	1,069	1,505	2,584
Thermoplastic Type	33,446	40,837	39,273	49,761	45,793
Total Polyurethane Products*	202,754	224,821	278,301	320,767	255,472

*Industry estimate.

Source: Semi-annual Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

ISOCYANATES
(in millions of pounds)

Year	Production			Sales & Captive Use
	Total	TDI*	Other Isocyanates	Total
1976	951	562	389	940
1977	1,011	582	429	1,047
1978	1,129	611	518	1,138
1979	1,248	681	567	1,234
1980	1,126	536	590	1,079

Participating Companies

Allied Corp.
BASF Wyandotte Corp.
Dow Chemical U.S.A.
E.I. duPont de Nemours & Co.
Mobay Chemical Corp.
Olin Corp.
Rubicon Chemicals, Inc.
The Upjohn Co.

POLYETHER POLYOLS
(in millions of pounds)

Year	Production	Sales & Captive Use
1976	1,208	1,186
1977	1,304	1,281
1978	1,404	1,399
1979	1,510	1,491
1980	1,225	1,231

Participating Companies

BASF Wyandotte Corp.
Choate Chemical
Dow Chemical U.S.A.
E.I. duPont de Nemours & Co.
Mobay Chemical Corp.
Olin Corp.
Owens-Corning Fiberglas Corp.
Pelron Corp.
PPG Industries
Quaker Oats Co.
Reichhold Chemicals, Inc.
Texaco, Inc.
U.C.T., Inc.
Union Carbide Corp.
The Upjohn Co.
Witco Chemical Corp.

POLYESTER POLYOLS
(in millions of pounds)

Year	Production	Sales & Captive Use
1977	28	26
1978	42	41
1979	43	41
1980	42	40

Participating Companies

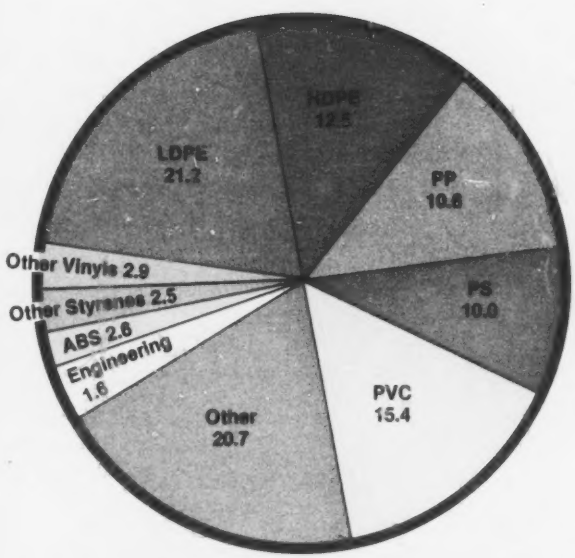
Hooker Chemical—Ruco Div.
Mobay Chemical Corp.
Union Carbide Corp.
Uniroyal Chemical Co.
Witco Chemical Corp.

*Toulene Diisocyanate (80/20 mixture).

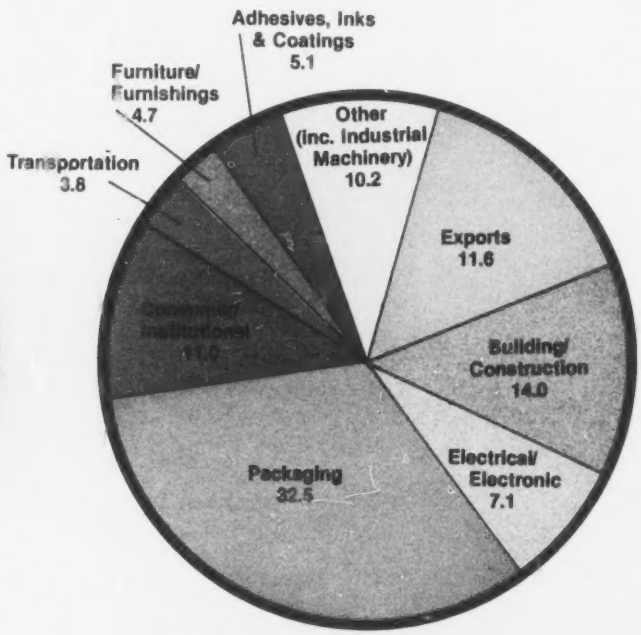
Source: Quarterly Polyols and Isocyanates Reports, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

THERMOPLASTIC RESINS

Plastics which in their final state as finished articles are capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature and physical change.



1980 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MATERIAL



1980 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MAJOR MARKET

ABS AND SAN

Manufacturing

Known Manufacturers:	ABS Estimated Capacity as of December 31: (millions of pounds) 1980	1981	1982	1983
Borg Warner Chemicals	600	600	750	750
Dow Chemical U.S.A.	300	300	300	300
Carl Gordon Industries	10	10	10	10
Mobay-Abson	70	70	70	70
Monsanto Company	525	525	525	525
USS Chemicals	180	180	180	180
Total	1,685	1,685	1,835	1,835

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production ABS	Production SAN	Sales & Captive Use ABS	Sales & Captive Use SAN
1976	988	113	925	104
1977	1,069	115	1,057	113
1978	1,134	120	1,118	121
1979	1,191	124	1,183	126
1980	920	111	916	103
Compound Growth Rate 1975-1980	7.5%	0.4%	8.1%	6.6%

Percent of Total U.S. Sales & Captive Use

	ABS	SAN
1976	3.43	0.39
1977	3.40	0.36
1978	3.19	0.35
1979	3.06	0.33
1980	2.60	0.29

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MAJOR DOMESTIC MARKETS
(in millions of pounds)

End-use	1978	1979	1980
ABS			
Pipe, Conduit & Fittings	356	302	208
Electrical & Electronic	n.a.	229	193
Transportation	n.a.	n.a.	154
Other	725	593	304
Total	1,081	1,124	859
SAN			
Total	104	108	90
Grand Total	1,185	1,232	949

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	265	291	303	317	185
Packaging	32	26	21	33	26
Building/Construction	266	333	346	341	234
Electrical/Electronic	211	246	278	257	265
Furniture/Furnishings	*	*	8	16	8
Consumer & Institutional	104	111	130	139	93
Industrial/Machinery	26	37	21	15	13
Adhesives, Inks & Coatings	*	*	—	—	—
All Other	83	85	78	114	125
Exports	42	40	54	77	69
Total	1,029	1,169	1,239	1,309	1,019

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

ENGINEERING THERMOPLASTIC RESINS

The following resins are generally considered to be included in the category of engineering resins: fluoropolymers; polyimides and polyamide-imides; modified polyphenylene oxide; polyphenylene sulfide; thermoplastic polyester resin; polycarbonate; polysulfone; and acetal. Other materials which may be used in similar applications such as ABS, SAN, and nylon are mentioned elsewhere in Facts & Figures. Fluoropolymers, likewise, are mentioned elsewhere but their production and sales & use data are included below.

Engineering resins are characterized by a combination of high ratings for mechanical, thermal, electrical, and chemical properties. Fillers such as glass, carbon, metallic oxides, metallic powders, calcium carbonate, and silica products, and reinforcements such as fibrous glass, asbestos, carbon, and other inorganic and organic fibers are added to improve these properties.

Typical Applications

Acetal (AC)	Sinks, faucets, electrical switches, gears, aerosol bottles, meat hooks, lawn sprinklers, ballcocks, shaver cartridges, zippers, telephone push-buttons.
Polycarbonate (PCO)	Helmets, power tool housings, battery cases, safety glass, auto lenses, 5 gal. bottles
Polyphenylene Sulfide (PPS)	Electrical connectors, coil forms, lamp housings.
Thermoplastic Polyester (TP)	Electrical bobbins, TV tuners, fuse cases, bearings, cams, auto ignition coil caps, speedometer frames, pump impellers and housings.
Polysulfone (PSO)	Electrical connectors, meter housings, coffeemakers, camera bodies, auto switch and relay bases, light-fixture sockets, fuel cell components, battery cases.
Modified Polyphenylene Oxide (PPO)	Auto dashboards, pumps, shower heads, plated auto grilles and trim, appliance housings, wiring splice devices, protective shields.
Polyimide (PI)	Radomes, printed circuit boards, turbine blades.
Polyamide-imide (PAI)	Valves, gears, pumps, high temperature magnet wire enamels.

Manufacturing

Known Manufacturers	AC	PCO	PPS	TP	PSO	PPO	PI	PAI	FLUORO-POLYMERS
Allied									X
Amoco Chemical							X	X	
Celanese Plastics & Spec.	X			X					
Dupont	X			X			X		X
Eastman Chemical				X					
GAF				X					
General Electric		X		X		X			
Goodyear				X					
ICI Americas						•			X
Mobay Chemical		X		X					
Phillips Petroleum			X						
Union Carbide					X				

(see opposite page for complete names of resins.)

Production and Sales & Captive Use (in millions of pounds and dollars)

Year	Production	Sales & Captive Use	Sales (excl. Captive & Exports)
1977	605	576	$486
1978	648	639	579
1979	729	709	699
1980	673	645	715

Compound Growth Rate of Sales & Captive Use	
1975-1980	8.3%
1979-1980	– 1.9%

Source: SPI Committee on Resin Statistics as compiled by Ernst & Whinney

Distribution by Major Market (in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	64	85	88	101	78
Packaging	—	1	3	8	1
Building & Construction	61	70	78	97	68
Electrical/Electronic	142	155	176	234	196
Consumer/Institutional	31	33	38	38	32
Industrial/Machinery	64	70	77	67	55
Other	24	23	30	21	42
Exports	110	128	129	146	106
Total	496	565	619	712	578

Source: Industry estimates.

FLUOROPOLYMERS

The fluoropolymers industry received its start with the discovery of polytetrafluoroethylene in 1938. Later during World War II its first use was as a gasket in packing materials in extremely corrosion-resistant applications for the Manhattan project. As the war progressed and radar became airborne, polytetrafluoroethylene was found to be the only insulation that had the required combination of electrical properties, toughness, and heat resistance to perform properly. Since this beginning other fluoropolymer resins have been made available and are in general use today. They are chlorotrifluoroethylene (CTFE), polyvinyl fluoride (PVF), polyvinylidene fluoride (PVF_2), fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), ethylene chlorotrifluoroethylene (ECTFE), and perfluoroalkoxy copolymerized with tetrafluoroethylene (PFA).

These fluoropolymer resins have an outstanding combination of properties and are capable of performance unavailable from any other group of resins. They have outstanding chemical resistance and are inert to virtually all chemicals and solvents, the most corrosive fuels or oxidizers and in the most difficult atmospheres. In addition, they do not contaminate other products with which they come in contact. They have high stable electric properties with minimum dissipation factor, low dielectric constants, high volume and surface resistivity, high dielectric strength, and are constant over a wide range of frequencies and temperatures. The useful temperature range for these resins is from $-400°$ to $+550°$F. They are among the most slippery solids known and provide excellent sliding surfaces for bearings and other applications. They have good physical properties which can be improved by reinforcing agents and are tough and flexible even at very low temperatures. Finally, they are unaffected by exposure to sun, freezing cold, or outdoor weathering of any kind.

As a result of this unusual combination of properties, fluoropolymers are used in virtually all areas of industry today. The most important of these are: (1) Electric—in shrinkable tubing, coaxial cable connectors, slip-on insulation, connectors, capacitors, and insulated wire; (2) Chemical—in pipe fittings, expansion joints, valves, seals, gaskets, seatings, laboratoryware, linings for valves and pumps, thread sealants, and other sealant products; and (3) Mechanical –in piston rings, valve seats, energy absorbing devices, cruise control parts, and bearing pads for the construction industry.

Fluoropolymers are also used in the aerospace and aircraft industry and more recently in medical and consumer markets. In the consumer field they are used to coat cookware, saw blades and also as components for such applications as coffee pots, urns, and toasters.

Suppliers of Granular PTFE Resins

Allied Corp.
American Hoechst Corp.
Custom Compounding
E.I. duPont de Nemours & Co.
ICI Americas
LNP Corporation
Mikro Technik
Montedison USA
Ugine Kuhlmann of America, Inc.

U.S. SALES OF FLUOROPOLYMER RESINS (GRANULAR TYPE ONLY)
(in thousands of pounds)

	1976	1977	1978	1979	1980
Virgin, First Quality	6,195	6,149	6,976	7,819r	7,310
Filled Resin, including colors	2,455	3,013	3,192	3,351	2,846
Miscellaneous lubricants, release compounds, etc.[1]	2,353	2,909	2,847	3,234r	3,349
Total	11,003	12,071	13,015	14,404r	13,505

r = revised from 1980 edition.
[1]. Includes broad specification second quality.
Source: SPI's Fluoropolymers Division.

HIGH DENSITY POLYETHYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds)			
	1980	1981	1982	1983
Allied Corp.	575	800	800	800
American Hoechst Corp.	220	220	220	220
Amoco Chemicals Corp.	340	340	340	340
ARCO/Polymers	325	325	325	325
Chemplex Company	300	300	300	300
Cities Service Co.	175	175	175	675
Conoco Chemicals Co.	—	—	—	430
Dow Chemical U.S.A.	500	500	500	500
DuPont, E.I. de Nemours & Co.	425	425	425	425
Exxon Chemical U.S.A.	—	—	440	440
Georgia-Pacific Corp.	—	—	—	240
Gulf Oil Chemicals	420	420	420	420
Hercules Incorporated	15	15	15	15
National Petrochemicals Corp.	500	500	500	500
Phillips Petroleum Co.	975	1,425	1,425	1,425
Soltex Polymers	750	750	750	750
Union Carbide Corp.	400	400	400	400
USS/Texaco Corp.	—	—	—	550
Total	5,920	6,595	7,035	8,755

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources:

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	3,125	3,127
1977	3,652	3,557
1978	4,201	4,165
1979	5,010	4,893
1980	4,405	4,394
Compound Growth Rate 1975-1980	12.3%	13.8%

	Percent of Total U.S. Sales & Captive Use
1976	11.59
1977	11.44
1978	11.88
1979	12.64
1980	12.49

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Film (12 mils & below)	95	136	189	212	201
Sheet (over 12 mils)	54	60	55	66	55
Injection molding	641	682	802	1,074	938
Wire & Cable	76	98	115	126	106
Extrusion Coating[a]	—	45	40	30	28
Blow Molding	1,147	1,258	1,461	1,724	1,573
Pipe & conduit	228	267	344	400	369
Other extruded products	65	24	21	19	24
All other uses	455	558	647	634	573
Total	2,761	3,128	3,674	4,285	3,867

[a]Included in other extruded products in 1976.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	38	42	62	90	85
Packaging	1,439	1,607	1,865	2,190	2,049
Building/Construction	265	308	413	445	428
Electrical/Electronic	87	138	170	210	167
Furniture/Furnishings	13	13	12	14	*
Consumer & Institutional	349	378	488	496	495
Industrial/Machinery	39	70	52	106	*
Adhesives, Inks & Coatings	—	—	—	—	—
All Other	530	575	612	733	644
Exports	366	426	491	609	526
Total	3,126	3,557	4,165	4,893	4,394

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

LATEX MATERIALS

Latex materials (sometimes referred to as emulsion polymers) are dispersions of the plastic polymer particles in water. Developed in the laboratory in the early 1930's, the first successful product was a synthetic rubber latex, commercialized during World War II to supplement the short supply of natural rubber latex.

A great variety and profusion of emulsions are now in commercial production. The most important of the plastic latexes are copolymers of styrene and butadiene, homopolymers and copolymers of vinyl acetate, acrylates, and vinyl chloride, as well as emulsions of polyvinyl chloride, polyvinylidene chloride, and other specialties. Other co-monomers used include fumarate, maleate, and ethylene.

The non-plastic synthetic rubber latices, excluded from SPI statistics, are elastomers categorized as Styrene/Butadiene (high butadiene), Polybutadiene, Acrylonitrile/Butadiene, Chloroprene, and Butyl. There is a significant amount of inter-product competition, particularly among the plastic types, and further there is competition with the synthetic and natural rubber latices which historically have been used.

The major end-uses for these plastic latex materials lie in four areas: (1) Adhesives—primarily in the packaging, construction, and wood products areas; (2) Coatings—primarily as a vehicle in water-based paints; (3) Paper—primarily as a clay coatings binder, but also used for saturating; and (4) Textiles—primarily as fabric finishes, sizes, back coats, and in fabric lamination and non-woven fiber bonding.

The emulsions and compounds are generally sold or used in relatively small batches (drums, tank trucks, and tank cars), and in many applications the emulsions are tailor-made to the end-use. There are thousands of end-users, some of whom polymerize for themselves, some of whom buy compounded material.

Each product sold has some unique characteristic desired in the end-use. For example, some adhesive resins should impart water resistance, fabric resins should be hard or soft depending on the type desired, and coatings resins should have good tint retention properties.

As a class these plastic emulsions have gained wide acceptance in the above mentioned end-uses for one or more of the following reasons:

—Water base (will meet the requirements of air pollution controls and regulations)
—Ease of clean-up
—Good adhesion to various substrates
—High pigment binding capacity
—Abrasion resistance and flexibility
—Uniform quality as compared with natural binders
—Good supply picture as compared with many of the natural binders
—Relative low cost versus binding efficiency
—Compatibility with existing technology and processes

Significant Producers*

Air Products & Chemicals
American Synthetic Rubber
ARCO/Polymers
AZS Corp.
Borden Chemical
Celanese Plastics & Specialties
Dow Chemical
DuPont
H.B. Fuller Company
Firestone Tire & Rubber
GAF Corp.
General Tire & Rubber
B.F. Goodrich Chemical
Goodyear Tire & Rubber
W.R. Grace
Monsanto Company
Morton Chemical
National Starch
Polysar Corp.
Reichhold Chemicals
Southwest Latex
Union Carbide Corp.
Union Chemical
Uniroyal Chemical
U.S. Industrial Chemicals

*Those producers in the SPI statistical report.

Production by product type and end-use is as follows:*

Product Type	Approximate % of Total
Polyvinyl acetate homopolymers and copolymers	30
Acrylic polymers	34
Styrene/butadiene polymers	31
All other	5
	100

End-Use	Approximate % of Total
Export	3
Domestic	97
Emulsion paint	26
Adhesives	15
Paper treating and coating	18
Textile and non-woven	12
Other	26
	100

STYRENE BUTADIENE & OTHER STYRENE BASED LATEXES

Styrene Butadiene Latexes are an outgrowth of the World War II development of GRS Latex used in the manufacture of synthetic rubber. The first large application was in the production of tablecloths in the late 1940's. About that time the first latex paint was introduced commercially. During the 1950's another large market developed, namely in coating formulations, clay, and in a variety of paper and paperboard products.

However, the largest market for SB Latexes developed in the 1960's. That was in the tufted rug industry, which was growing, at that time, at a rate of almost 20% per year. The advent of self-cure or carboxylated SB Latexes enabled the successful use of carpet-backing compounds.

Some other applications include non-woven binders, adhesives, textile inks, and in building products.

Significant producers are: American Synthetic Rubber, ARCO/Polymers, Borden, Dow, GAF, General Tire & Rubber, Goodrich, Goodyear, W.R. Grace, Hooker, Monsanto, Morton Industries, Polysar, Reichhold, Union Chemical and USS Chemicals.

Production and Sales & Captive Use
(thousands of pounds)

		Sales & Captive Use				
Year	Production	Paper Treating	Textile Treating	Carpet Backing	All Other	Total
1976	622,160	17,905	32,808	281,871	293,562	626,146
1977	675,660	56,313	39,436	325,896	239,229	660,874
1978	722,264	79,511	29,739	347,860	261,797	718,907
1979	736,866	21,694	24,644	360,961	328,708	736,007
1980	631,816	27,445	24,734	293,059	286,805	632,043

Source: Monthly Statistical Report, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1980	1981	1982	1983
ARCO/Polymers	400	400	400	400
Chemplex Company	410	410	410	410
Cities Service Company	525	725	725	725
Dow Chemical U.S.A.	1,025	1,175	1,175	1,400
DuPont, E.I. de Nemours & Co.	700	700	700	700
Eastman Chemical Products	350	350	350	550
Exxon Chemical U.S.A.	725	725	1,275	1,275
Gulf Oil Chemicals	850	850	850	850
Mobil Chemical Co.	300	300	300	300
Northern Petrochemical Company	560	560	560	560
Rexene Company	550	550	550	550
Union Carbide Corp.	1,375	1,500	2,450	2,450
U.S. Industrial Chemicals Company	700	700	700	700
Total	8,470	8,945	10,395	10,820

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	5,813	5,765
1977	6,471	6,488
1978	7,111	7,147
1979	7,793	7,815
1980	7,291	7,467
Compound Growth Rate 1975-1980	9.0%	9.6%

	Percent of Total U.S. Sales & Captive Use
1976	21.37
1977	20.86
1978	20.38
1979	20.19
1980	21.22

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Film (12 mils & below)	3,188	3,659	4,018	4,363	4,004
Sheet[a]	—	28	28	26	18
Injection molding	575	601	601	650	519
Wire & cable	352	404	422	424	335
Extrusion coating	454	478	489	539	517
Blow molding	51	54	56	60	65
Pipe & conduit	32	27	26	33	22
Other extruded products	54	59	68	80	56
All other uses	500	603	682	742	784
Total	5,206	5,913	6,390	6,917	6,320

[a]Included in Film in 1976.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	*	68	55	56	*
Packaging	3,538	3,944	4,462	4,796	4,582
Building/Construction	127	217	233	245	186
Electrical/Electronic	370	443	492	500	416
Furniture/Furnishings	*	*	*	*	15
Consumer & Institutional	650	696	681	672	570
Industrial/Machinery	35	71	*	*	*
Adhesives, Inks & Coatings	22	*	55	27	*
All Other	463	475	412	621	551
Exports	560	574	757	898	1,147
Total	5,765	6,488	7,147	7,815	7,467

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

NYLON

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds)			
	1980	1981	1982	1983
Adell Plastics, Inc.	20	20	20	20
Allied Corp.	70	70	70	70
American Hoechst Corp.	20	20	20	20
Badische Corp.	11	11	11	11
Belding Chemical Industries	2	2	2	2
Celanese Plastics & Specialities Company	40	40	40	40
Custom Resins, div. Bemis Co.	20	20	20	20
DuPont, E.I. de Nemours & Co.	160	160	160	160
Firestone Plastics Company	12	12	12	12
Monsanto Company	70	70	70	70
Rilsan Corp.	11	11	18	18
Shakespeare Co.	2	2	2	2
Texapol Corp. div. Dayco Corp.	4	4	4	4
Wellman, Inc.	8	8	8	8
Total	450	450	457	457

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1976	247	221
1977	254	250
1978	275	278
1979	327	315
1980	274	271
Compound Growth Rate 1975-1980	15.2%	13.6%

	Percent of Total U.S. Sales & Captive Use
1976	0.82
1977	0.80
1978	0.79
1979	0.81
1980	0.77

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Automotive and truck	63,061	82,968	93,494	100,878	77,972
Electrical and Electronic[1]	22,030	25,942	29,348	42,691	34,792
Appliances	8,022	11,090	14,070	14,684	7,061
Film and Coating[3]	n.a.	20,204	20,631	24,202	27,918
Wire and Cable	10,086	11,556	12,755	15,500	16,824
Monofilament[3]	n.a.	17,620	8,089	11,417	11,928
Consumer[2]	17,766	18,844	15,954	19,569	21,120
Others	83,229	46,068	62,714	56,414	50,434
Total	204,194	234,292	257,055	285,355	248,049

n.a. = not available

[1]Includes electrical and electronic applications not assignable to automotive and truck or appliance markets.
[2]Includes such items as housewares, brushes, combs, sporting goods, cameras and toys.
[3]Included in others in 1976.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	72	88	99	96	81
Packaging	22	22	24	31	28
Building/Construction	2	2	3	9	*
Electrical/Electronic	*	47	55	59	53
Furniture/Furnishings	7	*	*	*	8
Consumer & Institutional	16	18	16	15	17
Industrial/Machinery	17	15	19	26	20
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	68	41	41	50	41
Exports	17	17	21	29	23
Total	221	250	278	315	271

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYPROPYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds)			
	1980	1981	1982	1983
Amoco Chemicals	570	570	570	570
ARCO/Polymers	400	400	400	400
Eastman Chemical Products, Inc.	140	140	140	140
Exxon Chemical U.S.A.	400	400	400	400
Gulf Oil Chemicals Company	400	400	400	400
Hercules Incorporated	1,320	1,320	1,320	1,320
Northern Petrochemical Company	180	180	180	180
Phillips Petroleum Company	200	200	200	200
Rexene Company	275	275	275	275
Shell Chemical Company	600	600	600	600
Soltex Polymer Corp.	200	200	200	200
USS—Novamont Corp.	515	515	515	515
Total	5,200	5,200	5,200	5,200

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	2,632	2,536
1977	2,747	2,698
1978	3,074	3,055
1979	3,841	3,894
1980	3,648	3,714
Compound Growth Rate 1975-1980	13.9%	14.3%

	Percent of Total U.S. Sales & Captive Use
1976	9.40
1977	8.67
1978	8.71
1979	10.06
1980	10.56

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Injection molding, total	921	990	1,062	1,219	1,119
Appliances	86	94	93	99	87
Consumer products	158	157	178	278	301
Rigid packaging	168	179	185	208	225
Transportation	344	371	392	350	252
All other injection molding	165	189	214	284	254
Blow molding	37	50	59	62	63
Film (10 mils & below)	174	204	239	282	298
Sheet[a]	—	30	29	31	36
Other extruded products (including wire & cable, pipe & conduit, and extrusion coating)	126	81	79	97	84
Fiber & filaments	698	758	852	1,020	963
All other uses	224	302	371	469	472
Total	2,180	2,415	2,691	3,180	3,035

[a]Included in other extruded products in 1976.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	296	322	322	260	230
Packaging	490	421	477	722	720
Building/Construction	14	32	*	*	*
Electrical/Electronic	197	197	215	210	196
Furniture/Furnishings	618	472	564	759	727
Consumer & Institutional	272	504	518	539	505
Industrial/Machinery	*	*	34	54	52
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	294	468	561	636	604
Exports	355	282	364	714	680
Total	2,536	2,698	3,055	3,894	3,714

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYSTYRENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds)			
	1980	1981	1982	1983
A & E Plastic Pak	20	20	20	20
American Hoechst Corp.	620	620	620	620
Amoco Chemicals Corp.	400	400	400	400
ARCO/Polymers	475	475	475	475
BASF Wyandotte Corp.	180	215	215	215
Cosden Oil & Chemical Company	450	450	450	450
Dow Chemical Corp.	1,000	1,000	1,000	1,000
Georgia-Pacific Corp.	—	—	60	60
Carl Gordon Industries	100	100	100	100
Gulf Oil Chemicals	250	250	445	445
Huntsman-Goodson Chemical Co.	20	20	20	20
Kama Corp.	30	30	30	30
Mobil Chemical Corp.	200	200	200	200
Monsanto Company	800	800	800	800
Polysar Group	200	200	200	200
Shell Chemical Company	300	300	300	300
Texstyrene Co. (ETI)	20	20	20	20
USS Chemicals	200	200	200	200
Total	5,265	5,300	5,555	5,555

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	3,195	3,145
1977	3,446	3,557
1978	3,823	3,870
1979	4,005	3,997
1980	3,521	3,518
Compound Growth Rate 1975-1980	5.8%	5.9%

	Percent of Total U.S. Sales & Captive Use
1976	11.66
1977	11.44
1978	11.04
1979	10.32
1980	10.00

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Straight Polystyrene	1,504	1,703	1,828	1,906	1,761
Rubber-Modified Polystyrene	1,641	1,855	2,042	2,091	1,757
Total	3,145	3,558	3,870	3,997	3,518
Molding	1,565	1,718	1,814	1,901	1,596
Extrusion	912	1,132	1,245	1,314	1,083
Expandable Polystyrene Beads	379	385	407	445	431
All Other Uses	134	206	247	175	240
Total Domestic	2,990	3,441	3,713	3,835	3,350

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	*	*	21	23	13
Packaging	1,209	1,248	1,401	1,424	1,349
Building/Construction	228	350	320	350	277
Electrical/Electronic	319	354	375	383	301
Furniture/Furnishings	139	134	129	118	74
Consumer & Institutional	704	794	876	927	779
Industrial/Machinery	33	39	26	26	*
Adhesives, Inks & Coatings	*	*	—	—	*
All Other	358	522	566	585	557
Exports	155	116	156	161	168
Total	3,145	3,557	3,870	3,997	3,518

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL CHLORIDE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1980	1981	1982	1983
Air Products & Chemicals	360	360	360	360
Borden Chemical Company, The	500	500	500	800
Certain-Teed Products Corp.	220	220	220	220
Conoco Chemicals	550	850	850	850
Diamond Shamrock Corp.	500	625	625	625
Ethyl Corp.	180	180	180	180
Formosa Plastics (incl. Rico Chemical)	160	160	685	685
General Tire & Rubber Company	165	165	165	165
Georgia-Pacific Corp.	700	700	700	700
B.F. Goodrich Chemical Company, The	1,200	1,500	1,500	1,500
Goodyear Tire & Rubber Company, The	70	70	70	70
Great American Chemical Corp. (Whittaker Chem.)	60	60	60	60
Hooker Chemicals & Plastics	750	750	750	750
Keysor-Century Corp.	30	30	50	50
Pantasote Co. of New York, The	120	120	120	120
Shintech, Inc.	300	600	600	600
Stauffer Chemical Company	375	375	375	375
Talleyrand Chemicals	50	50	50	50
Tenneco Chemicals	720	900	900	900
Union Carbide Corp.	115	115	115	115
Total	7,125	8,205	8,750	9,050

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1976	4,716	4,638
1977	5,253	5,232
1978	5,723	5,810
1979	6,119	6,138
1980	5,470	5,407
Compound Growth Rate 1975-1980	8.4%	8.4%

	Percent of Total U.S. Sales & Captive Use
1976	17.19
1977	16.82
1978	16.57
1979	15.85
1980	15.37

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1976	1977	1978	1979	1980
Calendering, total	700	664	667	719	623
Flooring	165	171	153	173	138
Textile	91	152	146	110	94
All other calendering	444	341	368	436	391
Coating, total	476	488	532	489	370
Flooring	155	158	181	186	125
Textile & paper coating	150	153	141	138	119
Protective coatings	81	96	123	83	67
Adhesives & all other coatings	90	81	87	82	59
Extrusion, total	2,380	2,883	3,254	3,514	2,978
Wire & cable	330	384	400	409	368
Film & sheet	236	238	255	292	253
Rigid pipe & tubing (except fittings)	1,436	1,818	2,099	2,323	1,865
All other extrusions	378	443	500	490	492
Molding, total	416	468	535	503	415
Bottles	78	75	94	82	98
Sound records	150	175	211	160	114
Fittings (rigid pipe & tubing)	67	86	117	113	92
All other molding	121	132	113	148	111
Paste processes (except coating), total	148	164	169	184	154
Plastisol formulation	82	93	88	93	81
All other	66	71	81	91	73
Resellers	56	80	89	76	86
All other uses	190	246	321	331	316
Grand total	4,366	4,993	5,567	5,816	4,942

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1976	1977	1978	1979	1980
Transportation	249	219	278	270	195
Packaging	398	416	394	525	410
Building/Construction	2,063	2,644	3,150	3,167	2,690
Electrical/Electronic	594	602	643	623	539
Furniture/Furnishings	271	202	300	320	216
Consumer & Institutional	354	402	428	485	427
Industrial/Machinery	22	20	23	38	16
Adhesives, Inks & Coatings	169	141	103	92	79
All Other	246	347	248	296	370
Exports	272	239	243	322	465
Total	4,638	5,232	5,810	6,138	5,407

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL ACETATE

Polyvinyl acetate is produced by the emulsion polymerization of vinyl acetate to yield a water emulsion with a solids content of 50-55%. Commercial exploitation of this polymer began in the early 1930's, although its discovery dates from the early 1900's. Early production of the resin was primarily as a homopolymer, but more recently resin properties have been changed by including comonomers as n-butyl acrylate, 2-ethylhexyl acrylate, ethylene, dibutylmaleate, and dibutyl fumarate. Because of the large number of polyvinyl acetate producers, the numerous copolymers included and the variety of physical forms, polyvinyl acetate production is reported to SPI in terms of vinyl acetate monomer sold to or used by the polymerizer.

Polyvinyl acetate resins are primarily used in aqueous emulsions and find utility in adhesives, paints, textile finishes, and paper coating applications. A typical example of a polyvinyl acetate emulsion is the "white glue" used in many homes and schools.

There are more than 50 producers of polyvinyl acetate, supplied with monomer by such companies as Borden, Celanese Chemical, DuPont, National Starch, Union Carbide, and U.S. Industrial Chemicals.

SALES AND CAPTIVE USE OF VINYL ACETATE MONOMER FOR POLYVINYL ACETATE
(thousands of pounds)

Year	Emulsion Paint	Adhesives	Paper	Textile	Non-woven Binders	Others	Export	Total
1976	185,518	262,970	77,924	36,171	10,329	50,234	38,371	661,517
1977	231,479	268,175	76,565	30,249	16,416	42,447	12,244	677,575
1978	237,915	280,573	85,268	25,284	23,102	41,811	16,216	710,169
1979	287,617	257,520	87,627	28,935	30,062	46,513	20,782	759,056
1980	224,587	262,431	88,372	33,014	30,991	43,292	18,306	700,993

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL ALCOHOL

Polyvinyl alcohol was first prepared by Herrman and Haehnel in Germany in 1924 with commercial production beginning in the U.S. in the early 1930's. Polyvinyl alcohol is a unique polymer in that its monomer, vinyl alcohol, does not exist. It is produced from polyvinyl acetate by hydrolysis in either a batch or continuous process. This reaction can be controlled so that any degree of replacement of the acetate groupings can be produced. The degree of hydrolysis affects the resin properties such as water solubility, solvent resistance, adhesive strength, and other properties. Polyvinyl alcohol is primarily used as the fully-hydrolyzed product.

The principal uses of polyvinyl alcohol are in textile warp sizing, adhesive manufacture, as a suspending aid in polymerization, paper coatings, as an intermediate in the manufacture of polyvinyl butyral and in a variety of minor applications ranging from cosmetic manufacture to soil erosion control. The major manufacturers of polyvinyl alcohol in the U.S. are DuPont, Air Products, and Monsanto.

Production and Sales & Captive Use
(millions of pounds)

		Sales & Captive Use		
Year	Production	Domestic	Export	Total
1976	123,337	106,382	3,070	109,452
1977	119,217	112,997	5,262	118,259
1978	126,967	119,882	13,359	133,241
1979	147,702	123,857	24,451	148,308
1980	140,619	115,177	13,151	128,328

Compound Growth Rate Total Sales & Captive Use	
1975-1980	9.2%
1979-1980	−13.5%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

OTHER VINYL RESINS

Vinyl resins included in this category are polyvinyl butyral, polyvinyl formal, and polyvinylidene chloride and their respective copolymers containing at least 50% of the base resin.

Polyvinyl butyral and polyvinyl formal are prepared by reacting polyvinyl alcohol with butyraldehyde or formaldehyde in the presence of a strong mineral acid. There are many grades of these products in use, differing in degree of hydroxyl substitution and molecular weight. The largest end use of polyvinyl butyral is as the adhesive film in the lamination of auto safety glass. The major use of polyvinyl formal is in magnet wire coatings.

Polyvinylidene chloride is prepared by suspension or emulsion polymerization of vinylidene chloride. It finds major application as a film or as a coating on flexible substrates for packaging food products where oxygen impermeability and oil resistance are important.

Producers of these vinyl resins include Dow, DuPont, B.F. Goodrich, W.R. Grace, Monsanto, Morton Industries, Rohm and Haas, Union Carbide and Union Chemical.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1976	225,047	208,978
1977	196,763	193,893
1978	196,742	190,763
1979	220,154	212,779
1980	196,235	192,638

Compound Growth Rate of Sales & Captive Use	
1975-1980	2.2%
1979-1980	−9.5%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MISCELLANEOUS THERMOPLASTICS
(millions of pounds)

	Production				
Resin	**1975**	**1976**	**1977**	**1978**	**1979**
Acrylics	773	888	967	1,086	1,142
Cellulosics	157	n.a.	356	468	480
Petroleum hydrocarbons	299	306	334	319	321
Non-nylon polyamides	24	31	41	33	35
Polyterpenes	11	13	14	15	30
Rosin modifications	64	64	47	41	94
Other[1]	124	443	115	169	188

	Sales				
Resin	**1975**	**1976**	**1977**	**1978**	**1979**
Acrylics	n.a.	n.a.	n.a.	n.a.	n.a.
Cellulosics	139	n.a.	228	n.a.	333
Petroleum hydrocarbons	281	293	332	309	301
Non-nylon polyamides	23	28	40	33	34
Polyterpenes	10	13	14	15	30
Rosin modifications	50	63	47	42	85
Other[1]	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available

[1]Includes chlorinated polyolefins, coumarone-indene, fluoropolymers, polybutylene, polyphenyl aromatic esters, and other thermoplastics. Cellulosics also included in 1976.

Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE
(millions of pounds)

Material/Year	Total	Injection Molding	Extrusion	Blow Molding	Other
Grand Total					
1976	18,601	4,559	9,246	1,313	3,483
1977	21,156	4,995	10,882	1,437	3,842
1978	23,373	5,354	12,149	1,670	4,200
1979	25,443	6,010	13,143	1,928	4,362
1980	22,621	5,078	11,631	1,799	4,113
Growth Rate 1975-1980	8.8%	7.6%	9.2%	12.9%	7.4%
Polyolefins					
1976	10,147	2,137	5,542	1,235	1,233
1977	11,459	2,273	6,359	1,362	1,465
1978	12,755	2,465	7,014	1,576	1,700
1979	14,382	2,943	7,748	1,846	1,845
1980	13,222	2,576	7,116	1,701	1,829
Growth Rate 1975-1980	10.2%	9.9%	8.6%	13.1%	15.4%
LD Polyethylene					
1976	5,206	575	4,026	51	554
1977	5,914	601	4,655	54	604
1978	6,390	601	5,051	56	682
1979	6,917	650	5,465	60	742
1980	6,320	519	4,952	65	784
Growth Rate 1975-1980	7.4%	2.4%	7.0%	13.2%	15.8%
HD Polyethylene					
1976	2,761	641	518	1,147	455
1977	3,130	682	631	1,258	559
1978	3,674	802	764	1,461	647
1979	4,285	1,074	853	1,724	634
1980	3,867	938	783	1,573	573
Growth Rate 1975-1980	13.3%	15.4%	16.7%	12.8%	8.1%
Polypropylene					
1976	2,180	921	998	37	224
1977	2,415	990	1,073	50	302
1978	2,691	1,062	1,199	59	371
1979	3,180	1,219	1,430	62	469
1980	3,035	1,119	1,381	63	472
Growth Rate 1975-1980	12.9%	10.4%	10.9%	22.3%	30.2%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE
(millions of pounds)
(Cont'd.)

Material/Year	Total	Injection Molding	Extrusion	Blow Molding	Other
A B S					
1976	895	453	347	—	95
1977	1,029	533	451	—	45
1978	1,081	455	579	—	47
1979	1,124	550	500	—	74
1980	859	420	380	—	59
Growth Rate					
1975-1980	1.9%	−0.6%	6.2%	—	−2.5%
Polystyrene					
1976	2,989	1,565	912	—	512
1977	3,441	1,718	1,132	—	591
1978	3,713	1,814	1,245	—	654
1979	3,836	1,901	1,314	—	621
1980	3,350	1,596	1,083	—	671
Growth Rate					
1975-1980	1.7%	−0.1%	2.2%	—	6.1%
Nylon					
1976	204	134	65	—	5
1977	234	163	57	—	14
1978	257	179	57	—	21
1979	285	195	67	—	23
1980	248	169	74	—	5
Growth Rate					
1975-1980	8.4%	8.4%	10.0%	—	−6.5%
P V C					
1976	4,366	270	2,380	78	1,638
1977	4,993	308	2,883	75	1,727
1978	5,567	441	3,254	94	1,778
1979	5,816	421	3,514	82	1,799
1980	4,942	317	2,978	98	1,549
Growth Rate					
1975-1980	2.3%	5.8%	6.1%	5.8%	−3.9%

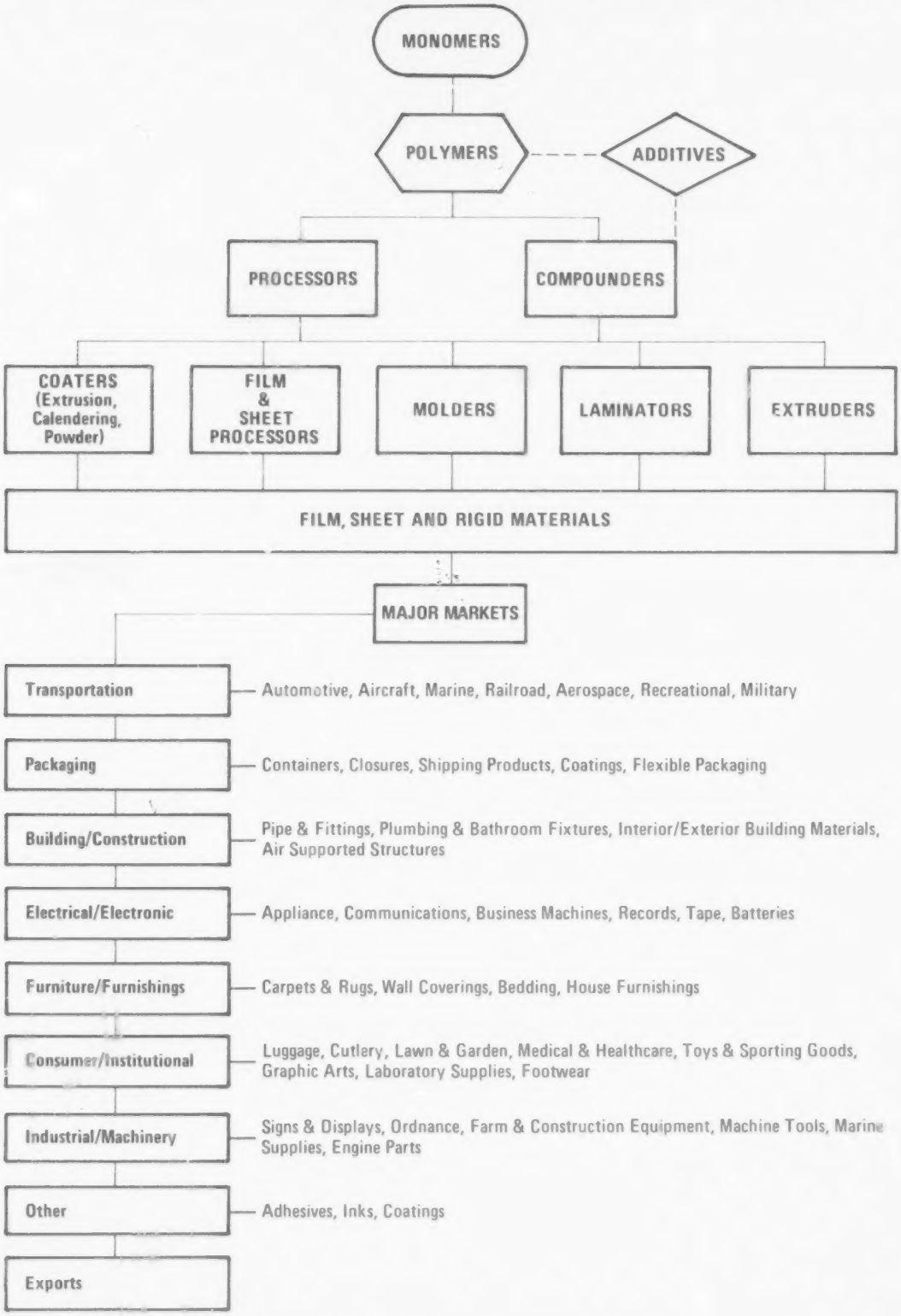
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

Courtesy: Plastics World Magazine/General Electric Plastics

This lightweight foamed plastic electrical enclosure complies with NEMA and JIC requirements. The enclosures weigh less than half as much as comparable metal units and have superior property characteristics.

FABRICATED PLASTIC PRODUCTS

FLOW CHART: FROM RAW MATERIAL TO FINAL PRODUCT



Source: SPI, Committee on Resin Statistics, *Major Markets Manual*.

REINFORCED PLASTICS

The combination of thermosetting unsaturated polyester resins with glass fiber accounts for the bulk of reinforced plastics products. Phenolics, vinyl esters, epoxies and fumarate resins bring thermosets' share of the market to almost 90%. The thermoplastics which account for the remainder, in general relative importance, are polyolefins, nylon, polycarbonate, styrenics, and polyvinyl chloride.

Random glass fibers are the volume reinforcement, but beads, flake, and woven mat and roving are other forms in which the glass may be used. For very high-performance or unique applications such as required in aerospace parts, or sporting goods shafts, carbon and graphite or certain synthetic fibers have a growing use experience. By weight the reinforcement is usually 25-35%, but 50% is not unusual in spray-up or press-molded materials.

Thermoset materials have been the choice for impact-strength, higher resistance to heat distortion, and resistance to corrosive environments. Thermoplastics are developing where large runs of uniform parts are a requirement, and where relatively smaller size of the parts makes processing feasible. In the last two years the reinforcement of foamed parts has become a reality in several markets.

Reinforced plastics production at the outset, during World War II, was almost entirely for military use such as in radomes. In recent years the marine market has dominated consumption, but even though its projected growth is 75% over the next five years it will probably soon take second place to transportation. The use of RP in automobiles could double over the next four years. The other high-volume growth market in the immediate future is chemical-resistance and pipeline application. All of the use categories for reinforced plastics are slated for faster growth than the economy generally.

The reinforced plastics industry enjoys a high level of technical activity because of the engineered nature of its products, and the relatively high value-added nature of the finished product. The search for new applications is vigorous, while new levels of performance in existing uses are continually being refined. Environmental and health concerns about styrene monomer, as well as continued demands of fire-retardant and non-toxic materials, suggest that research on basic resin characteristics will also continue.

The structure of the reinforced plastics industry has stabilized in recent years. Several materials suppliers have, in the pattern of other domestic industries, "integrated forward" by acquiring or developing fabrication divisions which specialize in a given manufacturing process or market, such as panels for light construction, corrosion-resistant equipment, or sanitaryware. More common, however, has been the development by large corporations identified with a given market, such as industrial pipe, automotive parts, or marine equipment, of a "captive" reinforced plastics operation which complements or replaces their metal or woodworking manufacturing. In the last decade custom molders have attempted to stabilize their role by selecting to produce several types of parts which they handle especially well, but spreading these selections over several market areas to minimize uneven business cycles. There have, of course, emerged large and small manufacturing companies who independently specialize in a given process or product. To complete the picture of the RP industry's diversity, we must mention that there is still room for the inventor/entrepreneur and, at the other end of the development process, there continues to be a considerable degree of university and laboratory research.

REINFORCED PLASTICS SHIPMENTS BY MARKET*
(Both Thermoset & Thermoplastic Resins)

	Shipments (in millions of pounds)					
Markets	**1976**	**1977**	**1978**	**1979**	**1980[1]**	**1981[2]**
Aircraft & Aerospace	22	23	22	23	25	28
Appliances & Equipment	98	112	123	130	104	112
Construction	248	276	323	335	265	309
Consumer Goods	102	116	116	126	99	110
Corrosion-Resistant Products	157	189	216	238	249	261
Electrical Rods, Tubes, Parts	123	154	170	190	162	178
Marine & Marine Accessories	365	400	430	385	275	375
Land Transportation	398	460	532	550	436	474
Miscellaneous	66	72	74	79	70	74
Total	1,579	1,802	2,006	2,056	1,685	1,871

[1] = estimate
[2] = forecast

*Source: Reinforced Plastics/Composites Institute, SPI.

By taking advantage of the manufacturing benefits of fiber glass reinforced plastic (FRP), engineers have made these RV's famous for their sleek lines, aerodynamic styling and durability. The high insulation qualities of fiber glass and foam also assures efficient heating during the coldest of winters.

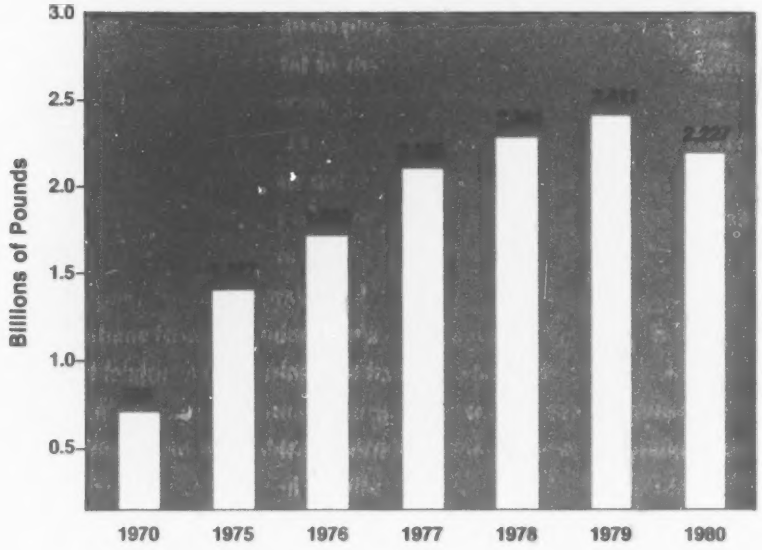
Courtesy: Plastics World Magazine/Owens-Corning Fiberglas

PLASTICS PIPE AND FITTINGS

In 1980, overall shipments of thermoplastic pipe and fittings declined 7.6% as compared with 1979. Plastic pipe consumption declined 7.5% while fittings were off 9.5%. All figures exclude corrugated polyethylene pipe.

Plastics pipe shipments dropped to 2.085 billion pounds from 2.254 billion pounds in 1979. Plastics fittings volume declined to 142.3 million pounds in 1980 versus 157.2 million pounds the year earlier.

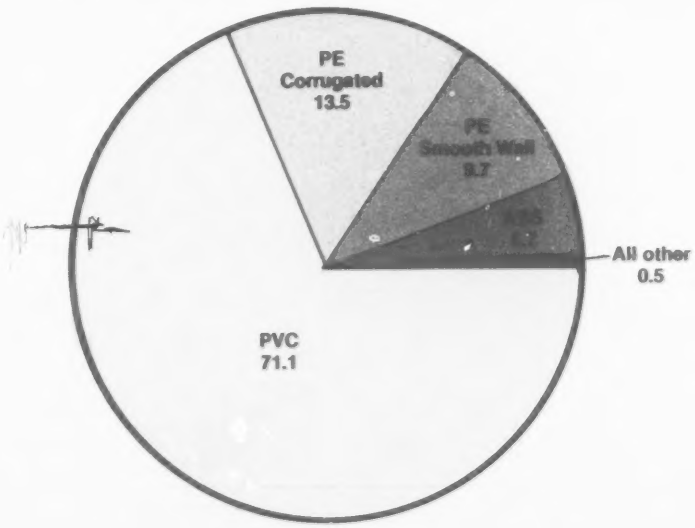
U.S. PLASTICS PIPE AND FITTINGS SHIPMENTS 1970-1980



Source: SPI Plastic Pipe Institute and Committee on Resin Statistics

Market Share

Polyvinyl chloride (PVC) enjoyed by far the largest share of all plastics materials going into pipe and fittings applications. In 1980 PVC accounted for 71.1% of all pipe shipments. This was slightly less than PVC's share of a year earlier when it had 72.2%. The chart below shows the 1980 distribution of plastics pipe shipments by material. Corrugated polyethylene pipe is estimated at 324 million pounds in 1980.



U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY MATERIAL
(in millions of pounds)

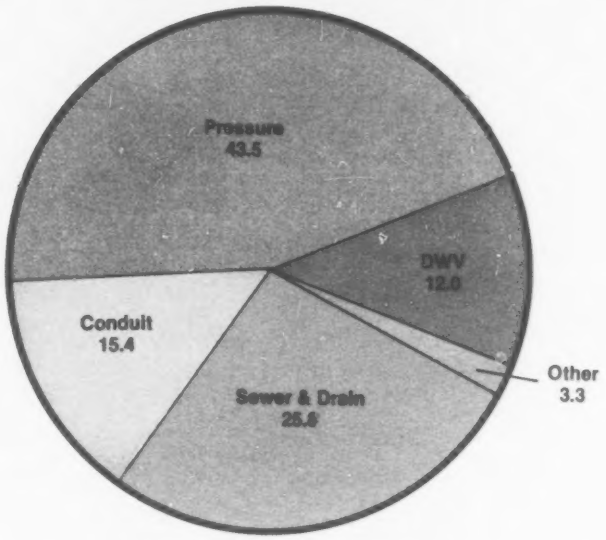
Year	Total	PVC	ABS	PE[1]	Other
1976	1,557	1,241	174	128	14
1977	1,992	1,612	211	155	14
1978	2,114	1,765	180	156	13
1979	2,254	1,860	185	197	12
1980	2,085	1,713	125	235	12
Growth Rate 1975-1980	10.3%	12.7%	2.2%	21.7%	−3.8%[2]

[1]Excludes corrugated
[2]1976-1980

U.S. PLASTIC PIPE SHIPMENTS BY MATERIAL 1980 vs 1979
(in millions of pounds)

Material	1980	1979	Change	% Change
PVC	1,713.2	1,860.4	−147.2	−7.9%
ABS	125.4	184.8	−59.4	−32.1
PE (Smooth wall)	234.7	196.6	+38.1	+19.4
Other	11.4	12.3	−0.9	−7.3
Total	2,084.7	2,254.1	−169.4	−7.5%

DISTRIBUTION OF PLASTICS PIPE SHIPMENTS BY APPLICATION—1980

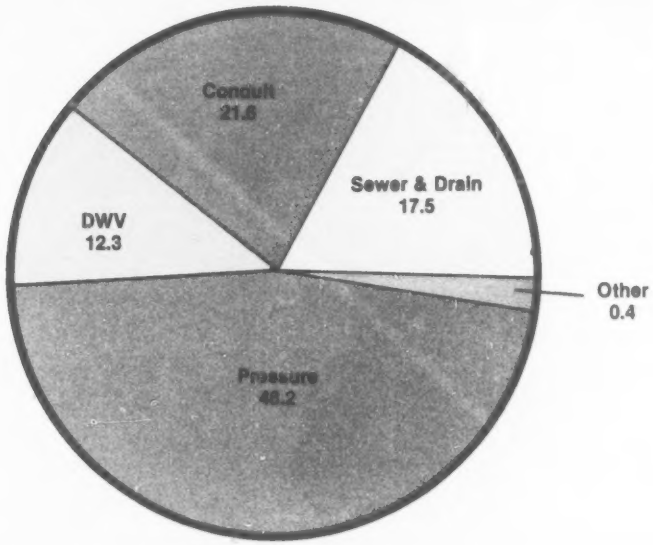


U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY APPLICATIONS
(in millions of pounds)

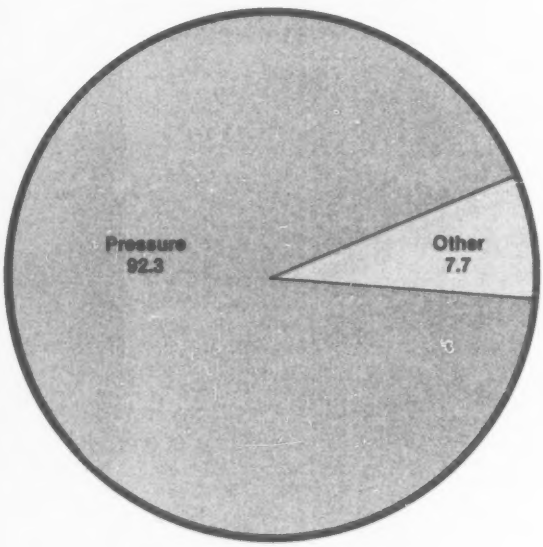
Year	Total	Pressure	Conduit	DWV	Other
1976	1,557	768	212	284	293
1977	1,992	972	268	368	384
1978	2,114	962	358	329	465
1979	2,254	1,058	406	313	477
1980	2,085	1,048	370	289	378
Growth Rate 1975-1980	10.3%	11.7%	15.5%	7.2%	5.4%

DWV = Drain, Waste & Vent

DISTRIBUTION OF PVC PIPE SHIPMENTS BY APPLICATION—1980

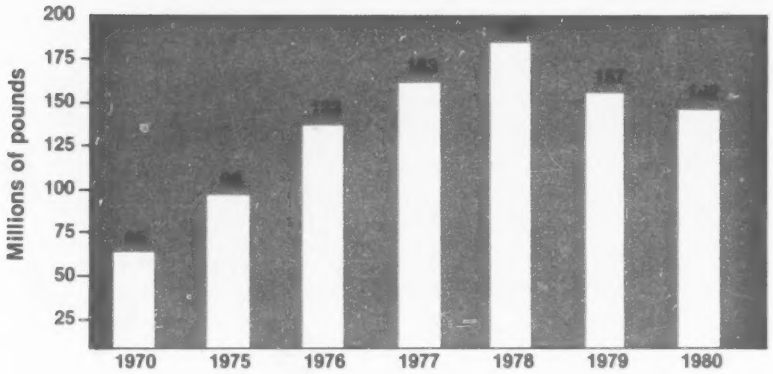


DISTRIBUTION OF POLYETHYLENE PIPE SHIPMENTS BY APPLICATION—1980



DISTRIBUTION OF ABS PIPE SHIPMENTS BY APPLICATION—1980

U.S. PLASTICS FITTINGS SHIPMENTS: 1979-1980



Source: SPI Plastic Pipe Institute and Committee on Resin Statistics.

U.S. PLASTICS FITTINGS SHIPMENTS BY MATERIAL
(millions of pounds)

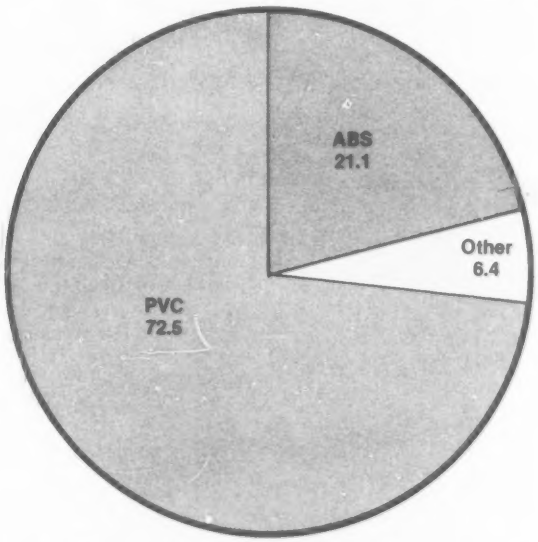
Year	Total	PVC	ABS	Other*
1976	133	82	42	9
1977	163	103	52	8
1978	187	118	59	10
1979	157	109	38	10
1980	142	103	30	9
Growth Rate 1975-1980	7.7%	11.8%	−0.6%	2.4%

*Includes polyethylene, chlorinated PVC, polyacetal, etc.

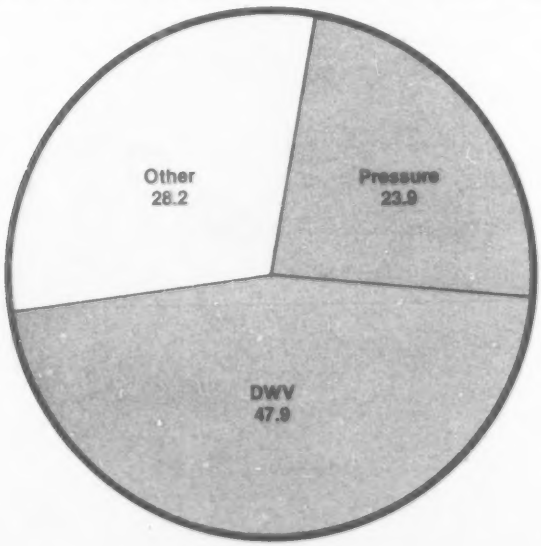
U.S. PLASTICS FITTINGS BY APPLICATION
(in millions of pounds)

Year	Total	Pressure	DWV	Other Non-Pressure
1976	133	23	84	26
1977	163	28	104	31
1978	187	32	117	38
1979	157	36	81	40
1980	142	34	68	40
Growth Rate 1975-1980	7.7%	12.3%	4.0%	11.7%

DISTRIBUTION OF PLASTICS FITTINGS BY MATERIAL-1980



DISTRIBUTION OF PLASTICS FITTINGS BY APPLICATION—1980



MAJOR MARKETS

The primary product groups for each Major Market category are listed below:

A. TRANSPORTATION
Motor Vehicles and Parts: including autos, trucks, buses, motorcycles, and bicycles. Ships, boats and recreational vehicles
All Other: including railroad equipment, travel trailers, campers, golf carts, snowmobiles, aircraft, military vehicles.

B. PACKAGING
Bottles, Jars, Vials
Food Containers: including disposable cups
Blister and Bubble Containers
Flexible Packaging: including household and institutional refuse bags and film
All Other: including tubes, tape, strapping, drums, caps, baskets, trays, boxes.

C. BUILDING AND CONSTRUCTION
Pipe, Conduit and Fittings: including drainage, irrigation, plumbing fixtures
Building Material for all Structures: including siding, flooring, and insulation materials.
All Other: including panels, doors, windows, skylights, bathroom units, gratings and railings.

D. ELECTRICAL AND ELECTRONIC
Home and Industrial Appliances: including electrical industrial equipment, wire and cable coverings, communications equipment.
Electronic Components: including resistors, magnetic tape, records, and storage batteries.

E. FURNITURE AND FURNISHINGS
All Types: including household and office furniture, bedding, carpets, rugs, backing, curtains, blinds, awnings, lamps, picture frames, wall coverings.

F. CONSUMER AND INSTITUTIONAL PRODUCTS
Dinner and Kitchenware: including picnicware.
Toys and Sporting Goods
Health Care and Medical Products: including laboratory supplies.
Hobby and Graphic Arts Supplies: including photographic equipment and supplies.
All Other: including footwear, luggage, buttons, lawn & garden tools, waste baskets.

G. INDUSTRIAL/ MACHINERY
All Types: including engine and turbine parts, farm and garden machinery, construction and related equipment, machine tools, signs and displays, ordnance and firearms.

H. ADHESIVES/INKS/COATINGS
Adhesives and Sealants
All Other: including printing ink, magnet wire enamels, core binders, foundry facings, paper coating and glazing, paints, varnishes, and enamels.

I. RESELLERS/COMPOUNDERS
Sales of Resins Sold to Resellers, Compounders, Converters.
Unclassified Sales: including calenderers whose end-use markets cannot be ascertained by the resin supplier, or resin that cannot be classified under any of the Major Market categories listed above.

J. EXPORTS
Sales of Plastic Resin exported from the U.S.

1980 RESULTS

The 1980 data reflect major market plastics resins sales and captive use data compiled by Ernst & Whinney with consumption data being reported by individual resin. The plastics resins categories included in this study are:

THERMOSETS

Epoxy
Polyester, Unsaturated
Urea and Melamine
Phenolic
All Other Thermosets

THERMOPLASTICS

Low Density Polyethylene
High Density Polyethylene
Polypropylene
Acrylonitrile-Butadiene-Styrene (ABS) and Styrene-Acrylonitrile (SAN)
Polystyrene
Styrene Butadiene Latexes (SBL), and Other Styrene Based Latexes (OSBL), and Other Styrene Based Polymers (OSBP)
Nylon
Polyvinyl Chloride
All Other Thermoplastics

In addition, sales and captive use of polyurethane are reported separately by Major Market total only in an appendix to this report.

COMPARISON OF 1980 DATA TO PRIOR YEARS
FIVE YEAR COMPARISON OF RESIN SALES & USE BY MAJOR MARKET*
(millions of pounds, dry weight basis)

Major Market	1976	1977	1978	1979	1980
Transportation	1,808	1,911	2,015	1,934	1,605
Packaging	7,342	7,889	9,044	10,334	10,003
Building/Construction	4,555	6,008	6,965	7,573	6,424
Electrical/Electronic	2,524	2,756	2,952	3,043	2,453
Furniture/Furnishings	1,617	1,391	1,686	1,894	1,646
Consumer & Institutional	2,801	3,242	3,592	3,753	3,553
Industrial/Machinery	319	472	380	517	391
Adhesives, Inks & Coatings	2,330	2,566	2,902	2,794	2,387
All Other	2,160	2,728	2,939	3,443	3,054
Exports	2,168	2,142	2,588	3,432	3,670
Total	27,624	31,105	35,063	38,717	35,186

*Note: All figures exclude polyurethane

SHARE OF MARKET

The data reported by the Major Markets Subcommittee enables one to determine the fastest growing plastics markets. The data show, for example, the increasing role of "packaging" as a consumer of plastics resins in 1980.

COMPARATIVE PERCENTAGE DISTRIBUTION BY MAJOR MARKET

Major Market	1976	1977	1978	1979	1980
Transportation	6.5%	6.1%	5.7%	5.0%	4.6%
Packaging	26.6	25.4	25.8	26.7	28.4
Building/Construction	16.5	19.3	19.8	19.6	18.3
Electrical/Electronic	9.1	8.9	8.4	7.9	7.0
Furniture/Furnishings	5.9	4.5	4.8	4.9	4.7
Consumer & Institutional	10.1	10.4	10.3	9.7	10.1
Industrial/Machinery	1.2	1.5	1.1	1.3	1.1
Adhesives, Inks & Coatings	8.4	8.2	8.3	7.2	6.8
All Other	7.8	8.8	8.4	8.9	8.6
Exports	7.8	6.9	7.4	8.8	10.4
Total	100.0%	100.0%	100.0%	100.0%	100.0%

*Note: All figures exclude polyurethane

SUMMARY

These Major Market data demonstrate the important relationship between the plastics industry and the general economy. The factors affecting each are common to both: consumer buying attitudes; balance of trade; value of the dollar (inflation); the energy situation; the role of Government regulations; and the desire to increase productivity.

Advances in technology through combinations of plastics, and the use of additives and reinforcements have made plastics important basic raw materials. Plastics consumption continues to grow with consumer acceptance of plastics products not only as replacements for other materials but also where new markets are created through plastics' unique properties and versatility. The concept of plastics as basic materials has opened a new era for the industry.

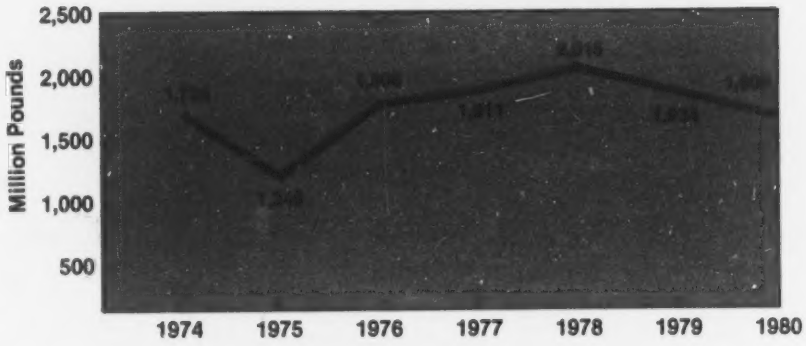
PERCENTAGE CHANGE IN SALES AND USE BY MAJOR MARKET

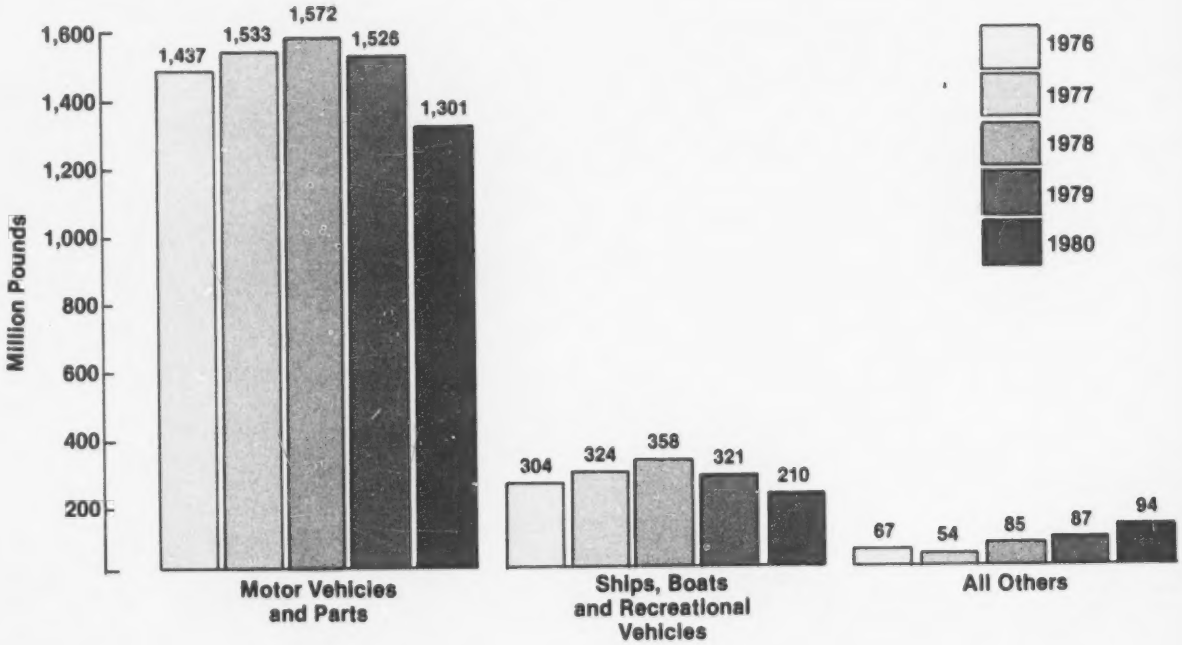
Major Market	% CHANGE 1979/1980	% CHANGE 1978/1979	% CHANGE 1975/1980
Transportation	−17.0%	− 4.0%	+ 5.2%
Packaging	− 3.2	+14.3	+12.4
Building/Construction	−15.2	+ 8.7	+11.5
Electrical/Electronic	−19.4	+ 3.1	+ 6.5
Furniture/Furnishings	−13.1	+12.3	+ 3.9
Consumer/Institutional	− 5.3	+ 4.5	+ 4.3
Industrial/Machinery	−24.4	+36.1	+ 4.6
Adhesives/Inks/Coatings	−14.6	− 3.7	+4.2
All Other	−11.3	+17.1	+11.5
Exports	+ 6.9	+32.6	+22.2
Total	− 9.1%	+10.4%	+ 9.9%

ANALYSIS BY MAJOR MARKET

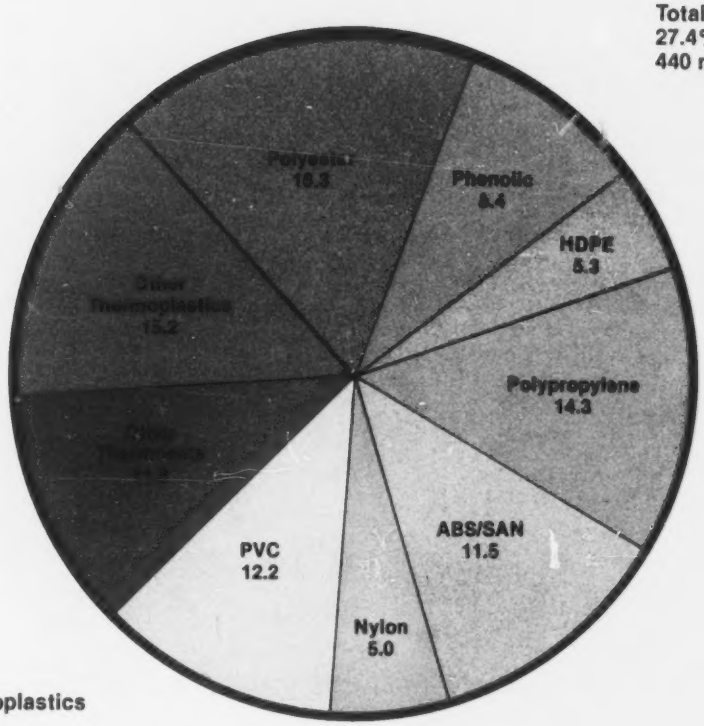
Note: Because of non-comparable "line-item" data, polyurethane foam is not included in the tables and graphs of this section. However, polyurethane foam consumption data by major market is provided in Appendix B.

TRANSPORTATION





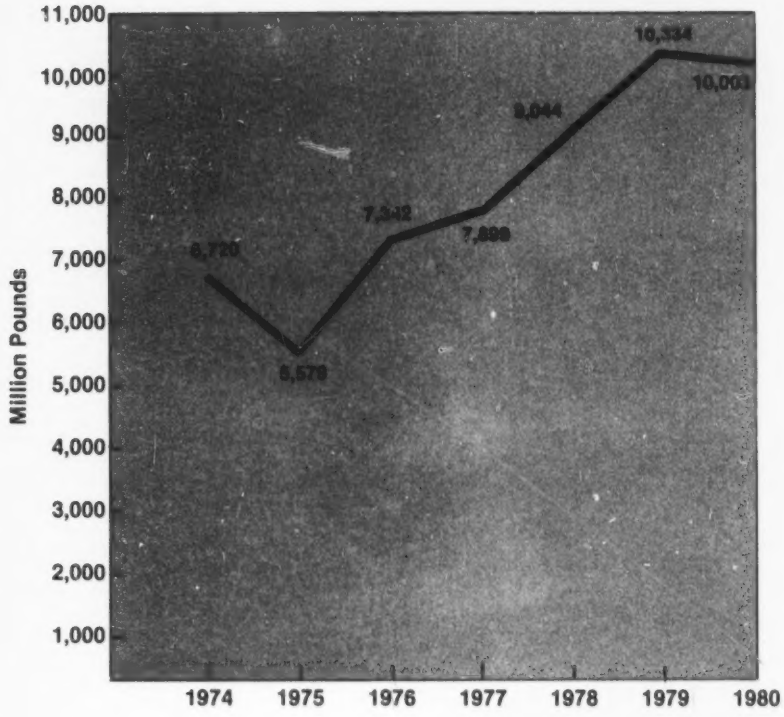
TRANSPORTATION (cont'd).

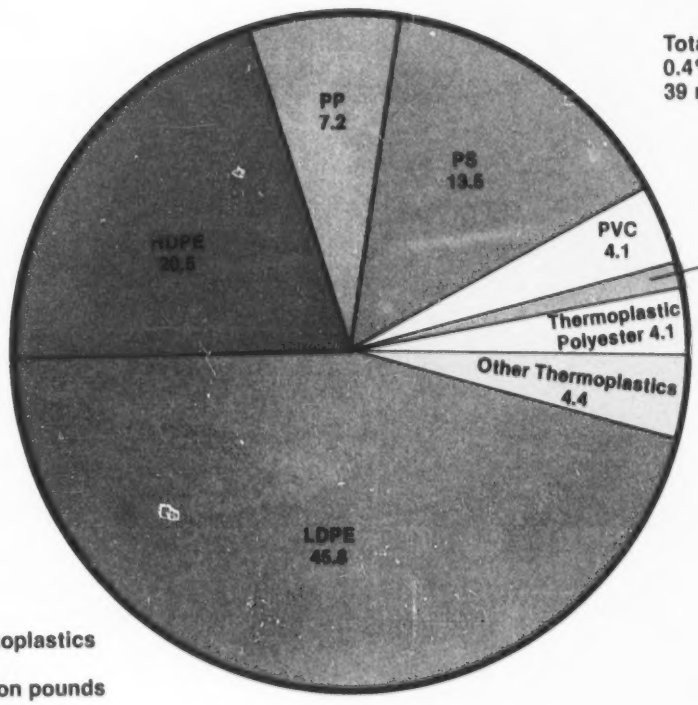


Total Thermosets
27.4%
440 million pounds

Total Thermoplastics
72.6%
1,165 million pounds

PACKAGING

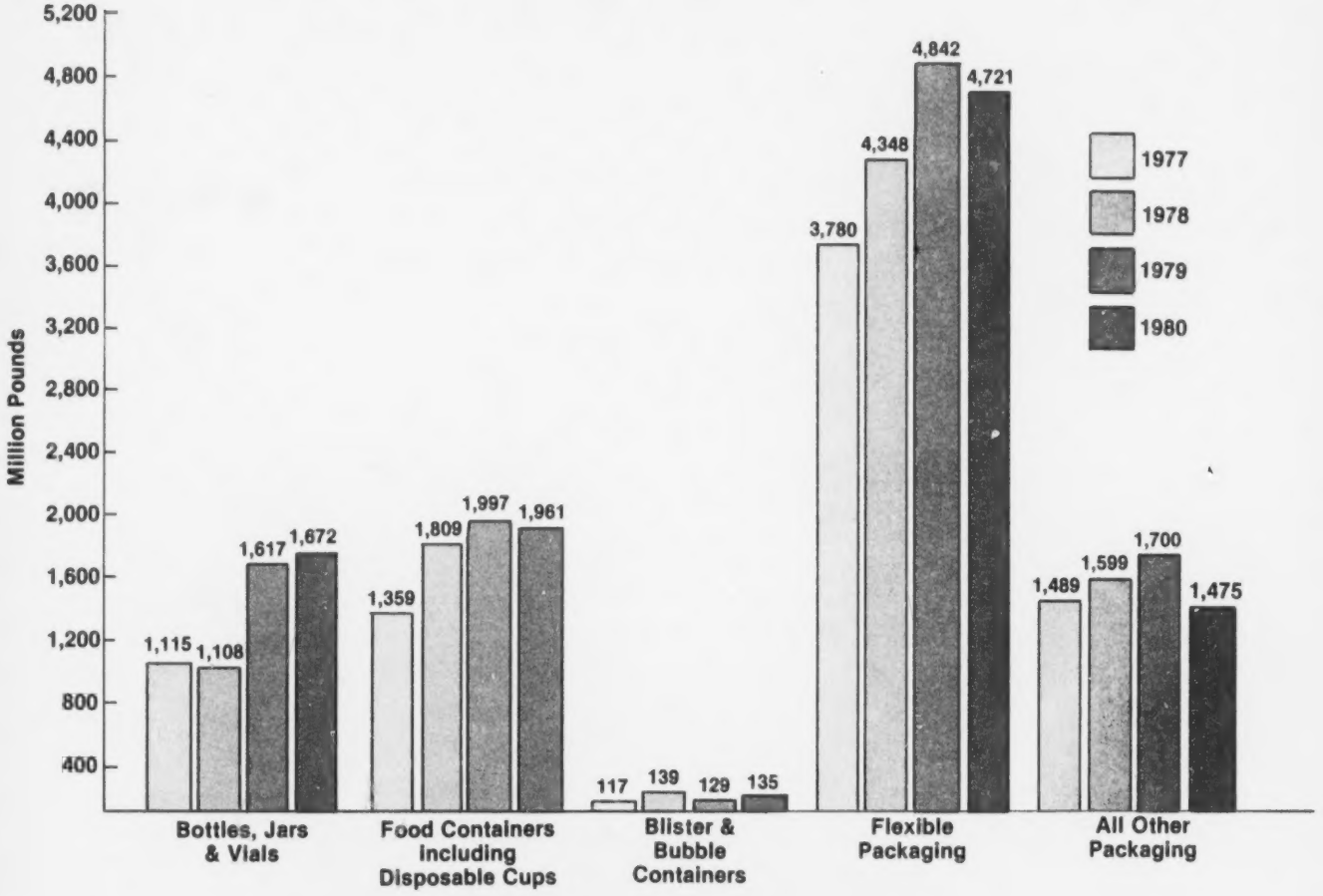




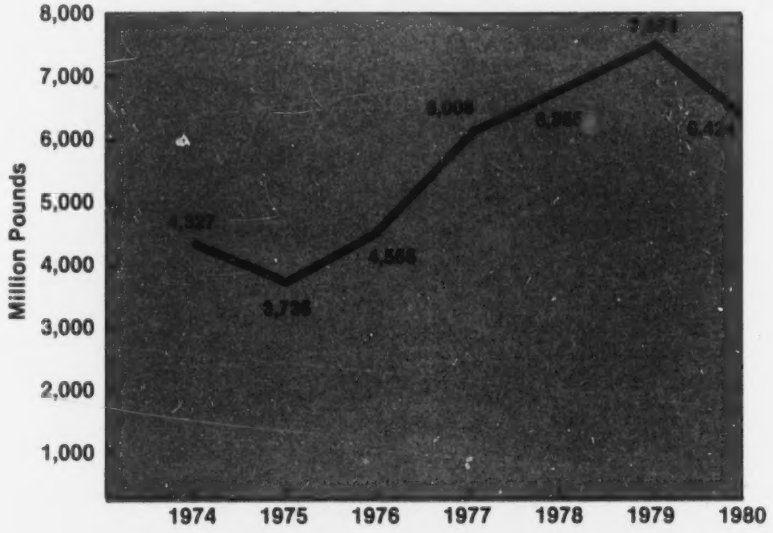
Total Thermosets
0.4%
39 million pounds

Total Thermoplastics
99.6%
10,003 million pounds

PACKAGING — THERMOPLASTIC DISTRIBUTION



BUILDING AND CONSTRUCTION



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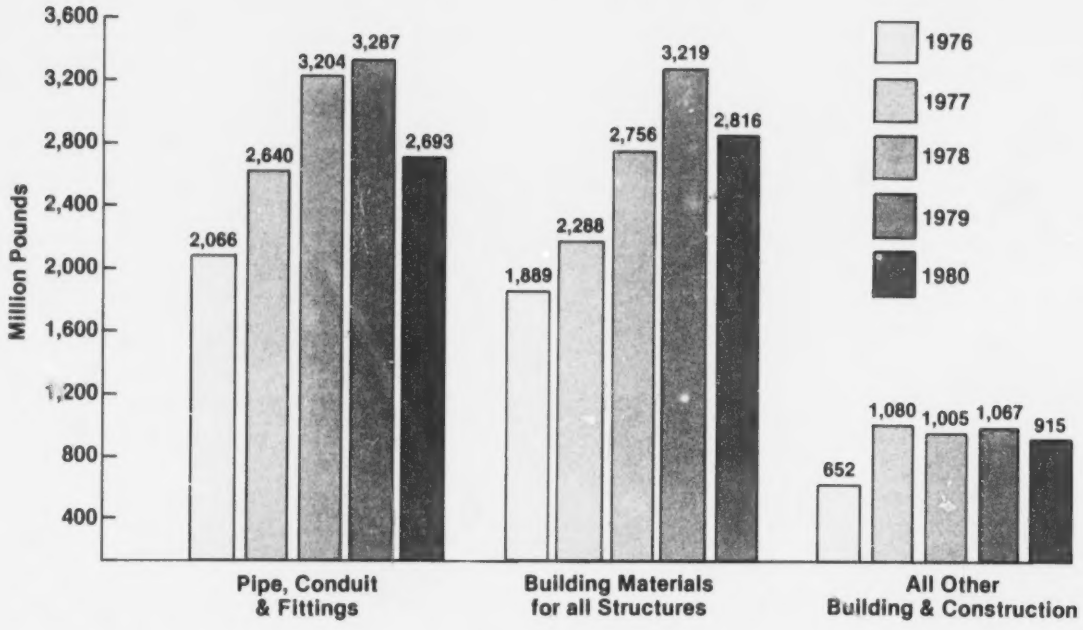
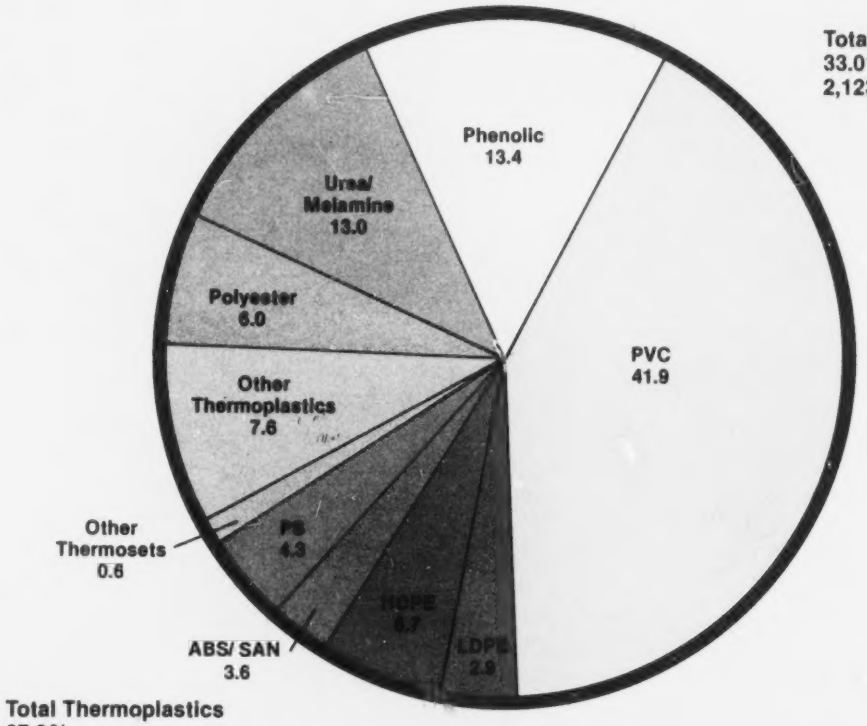
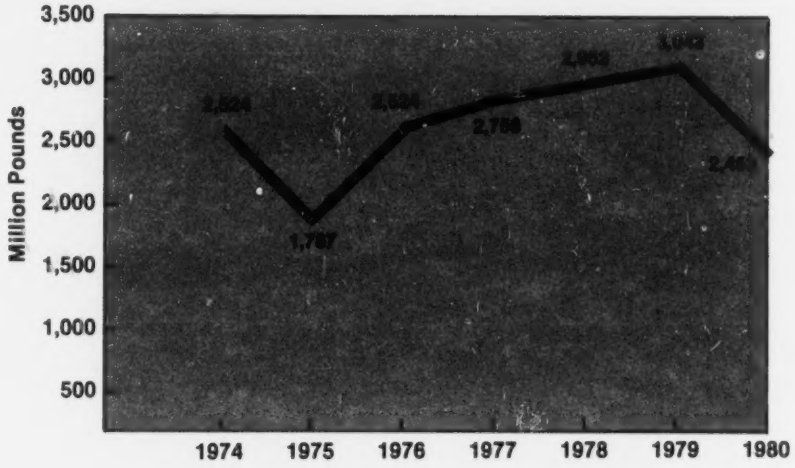
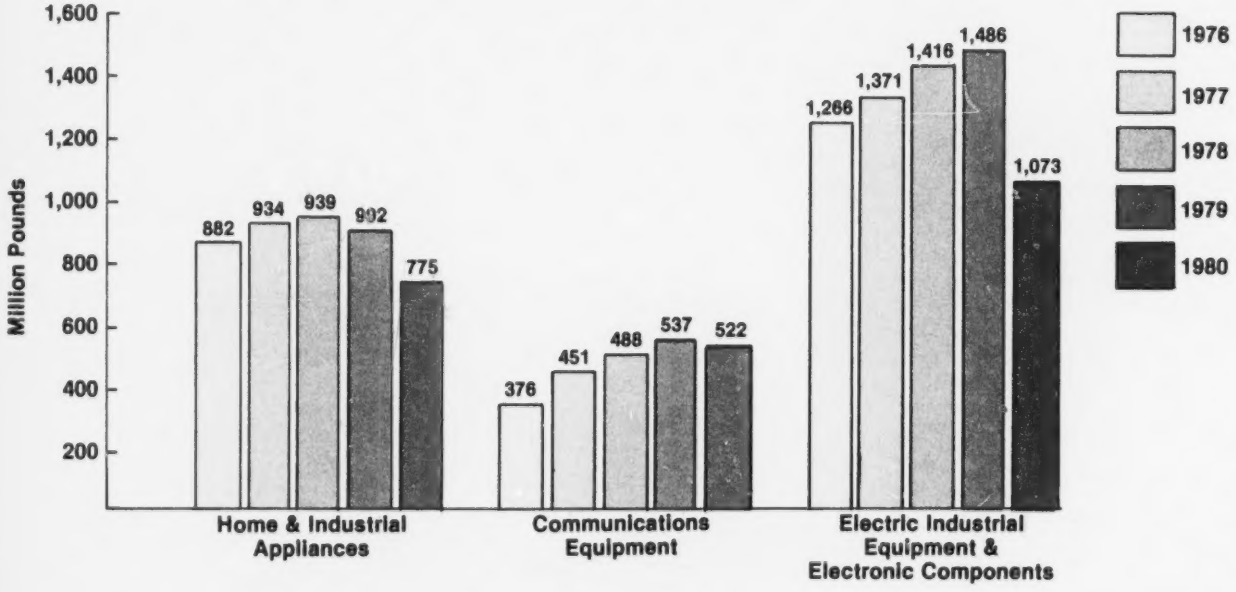




ELECTRICAL AND ELECTRONIC





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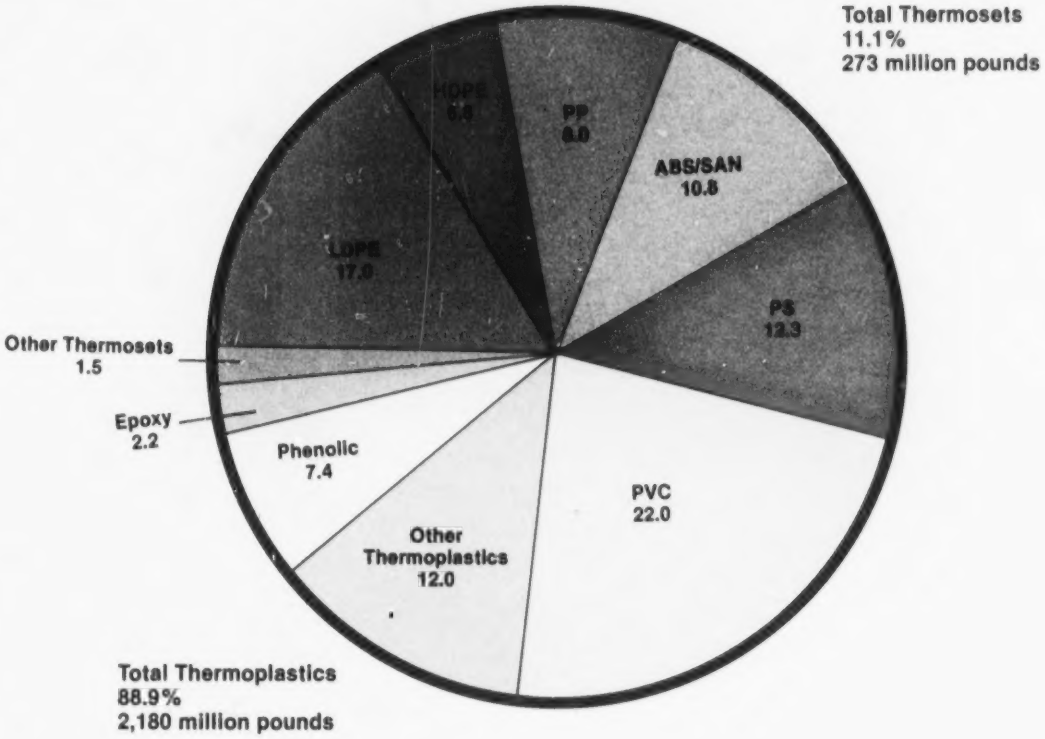
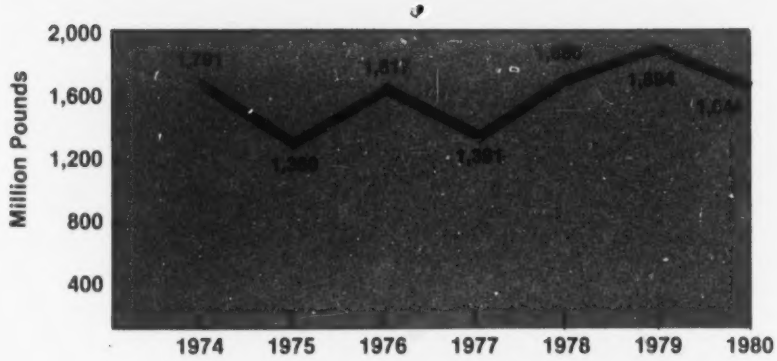
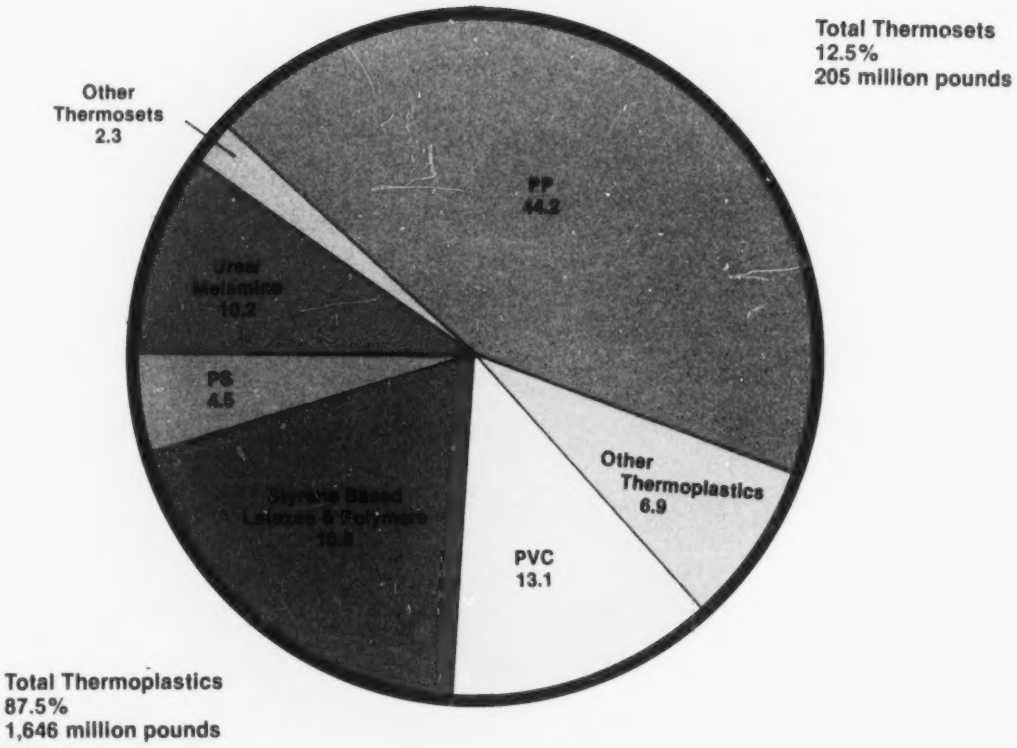
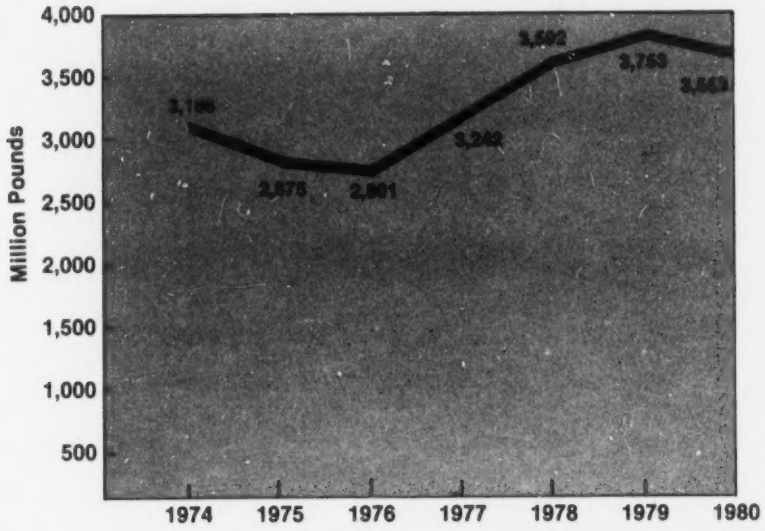


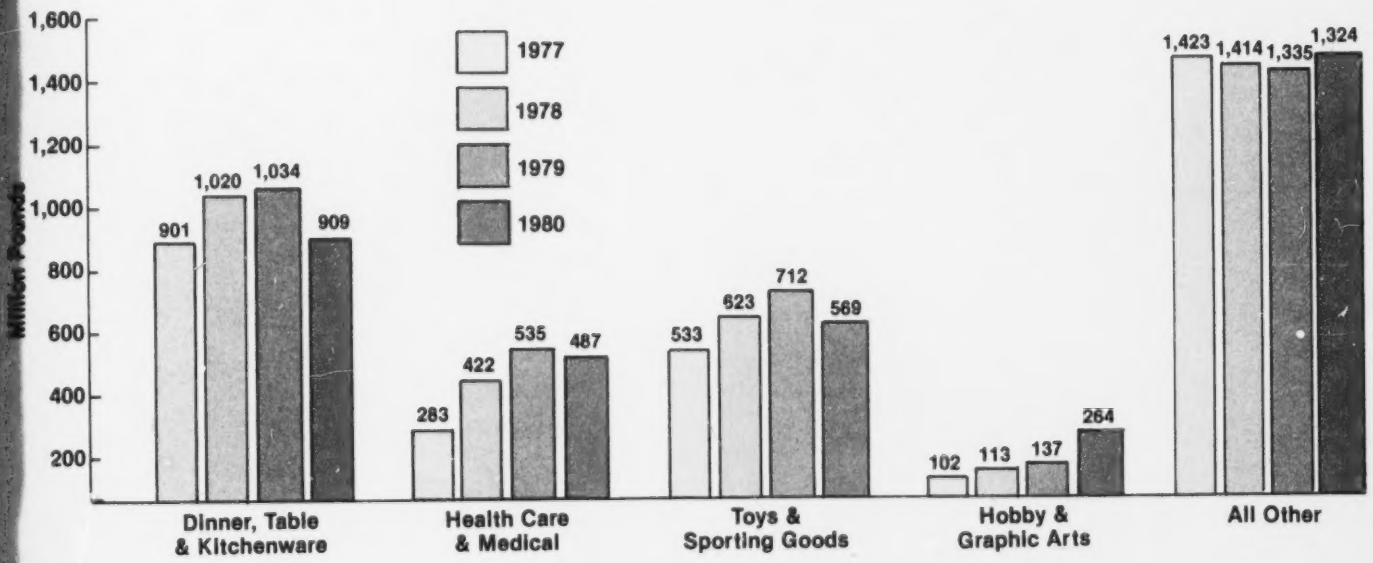
FURNITURE AND FURNISHINGS



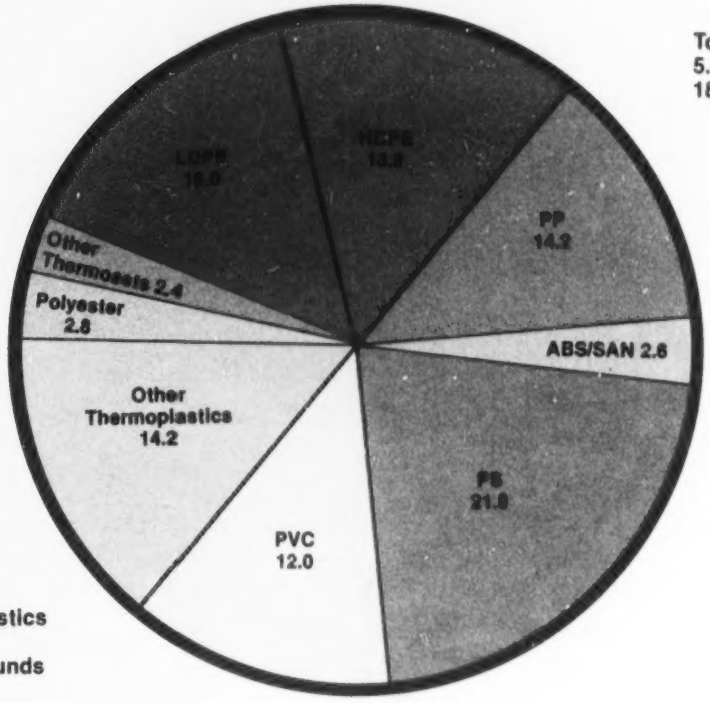


CONSUMER AND INSTITUTIONAL





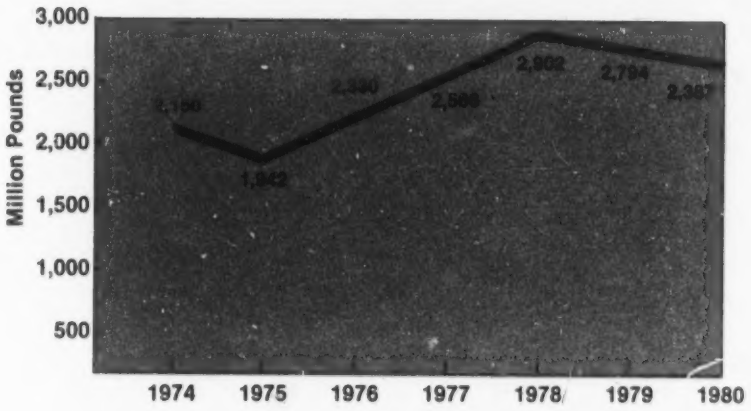
CONSUMER AND INSTITUTIONAL (cont'd.)

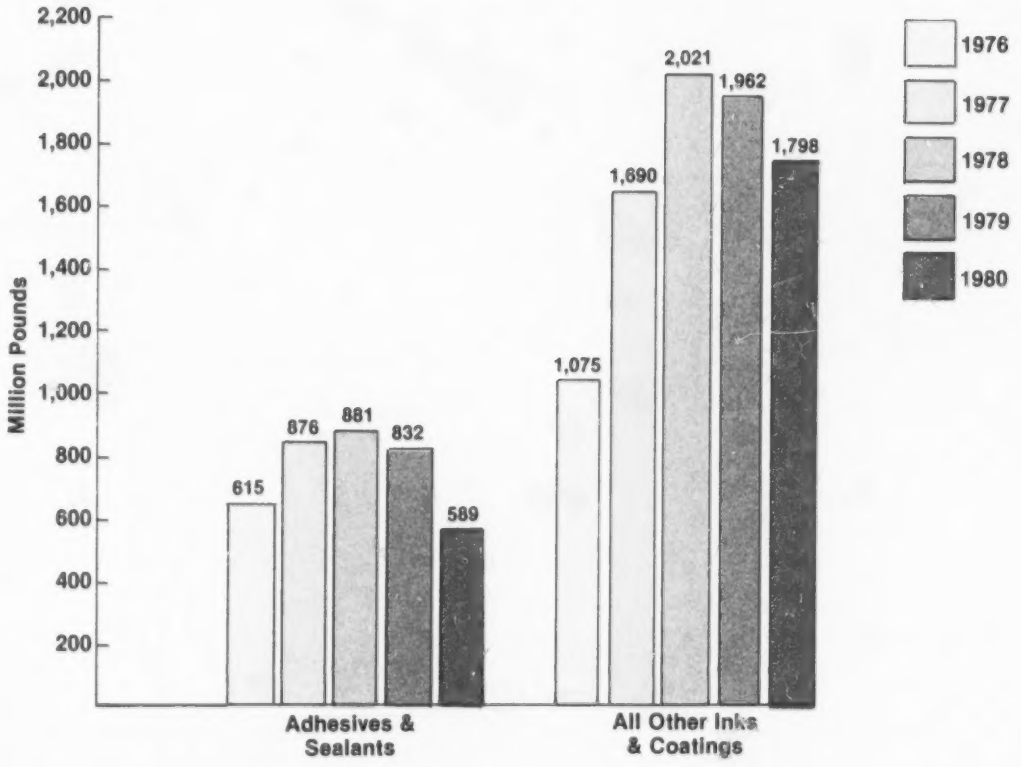


Total Thermosets
5.2%
184 million pounds

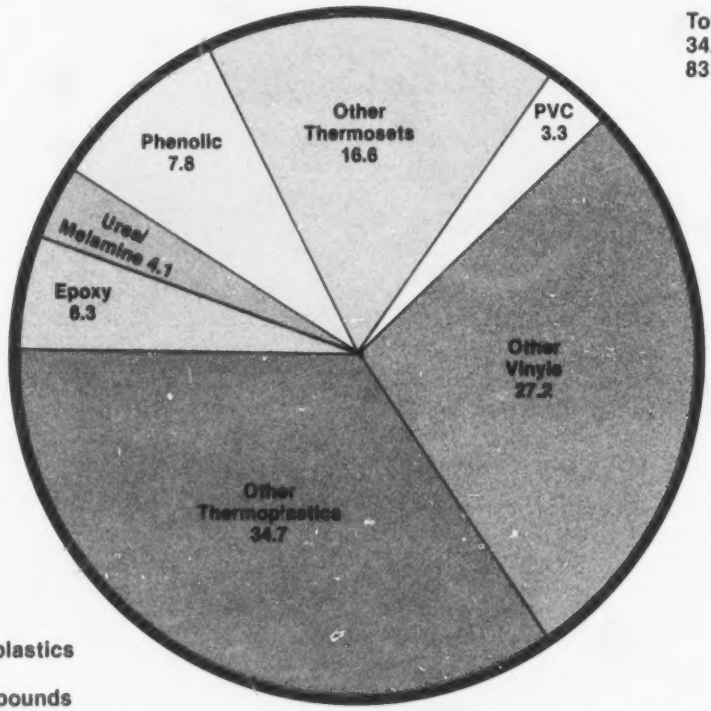
Total Thermoplastics
94.8%
3,553 million pounds

ADHESIVES/INKS/COATINGS





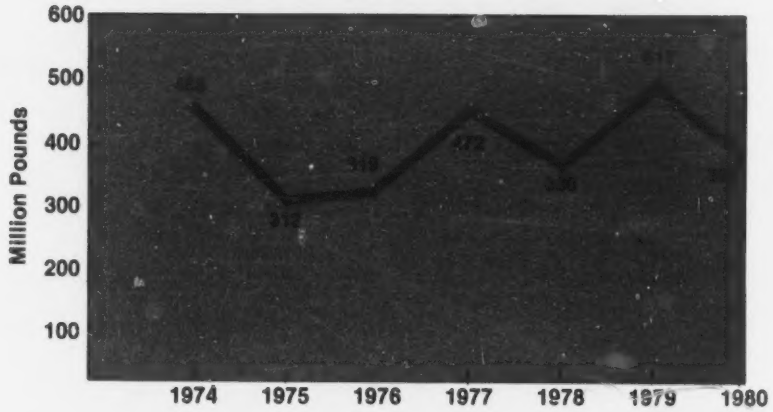
ADHESIVES/INKS/COATINGS (cont'd.)

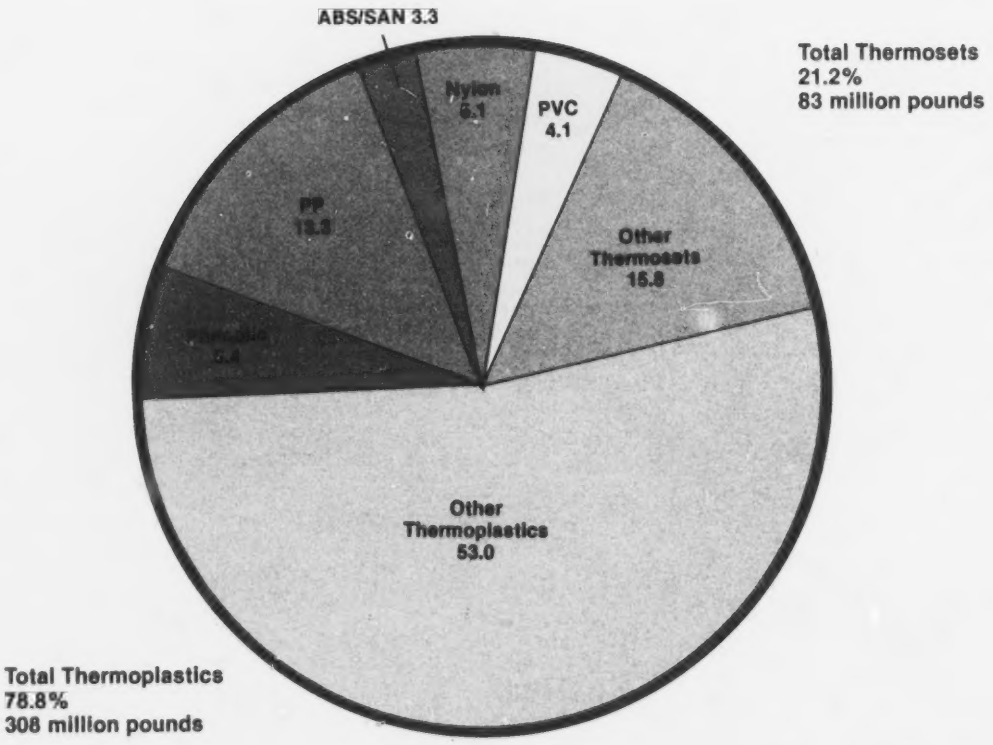


Total Thermosets
34.8%
831 million pounds

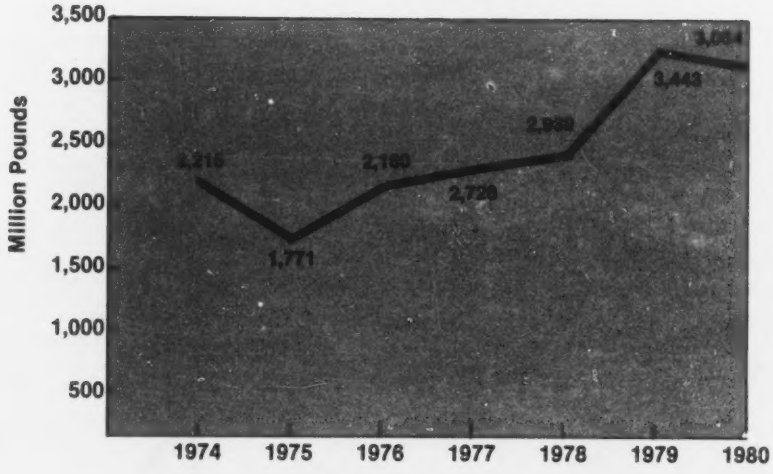
Total Thermoplastics
65.2%
1,556 million pounds

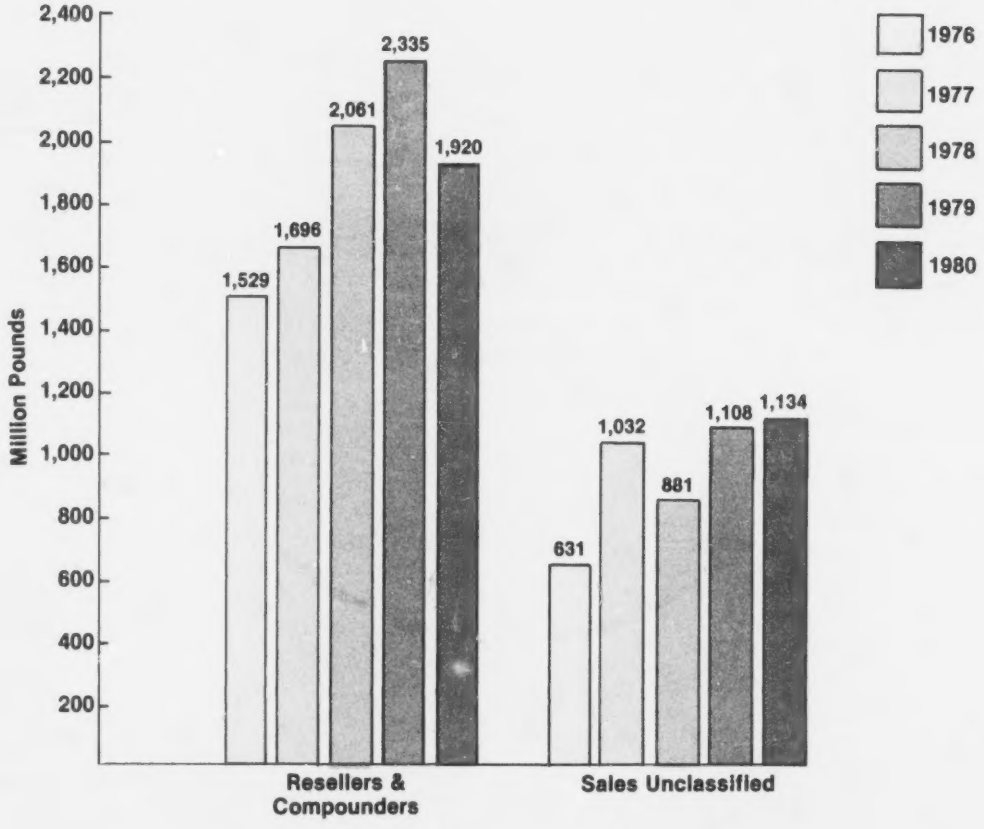
INDUSTRIAL/MACHINERY



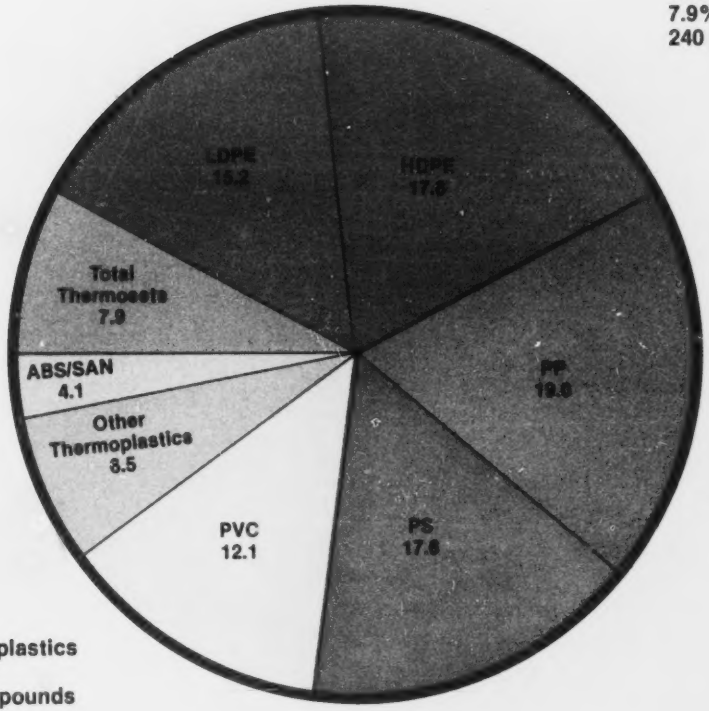


ALL OTHER


Million Pounds
3,500
3,000
2,500
2,000
1,500
1,000
500
2,215
1,771
2,160
2,729
2,939
3,443
3,054
1974
1975
1976
1977
1978
1979
1980


Million Pounds
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
1,529
1,696
2,061
2,335
1,920
631
1,032
881
1,108
1,134
Resellers & Compounders
Sales Unclassified
1976
1977
1978
1979
1980

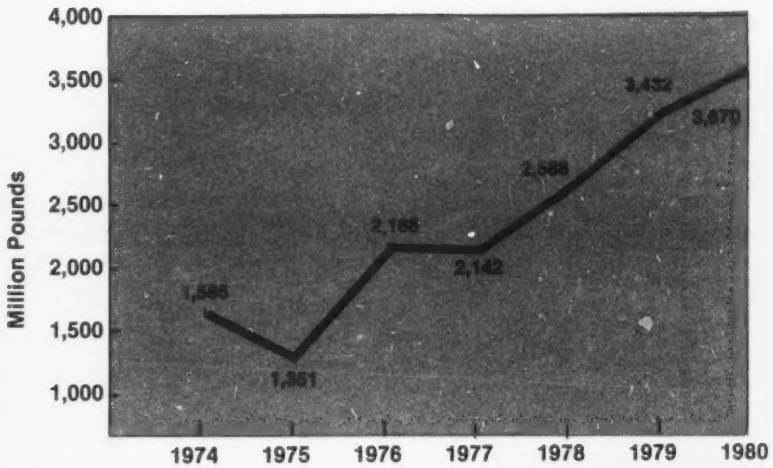
ALL OTHER (cont'd.)

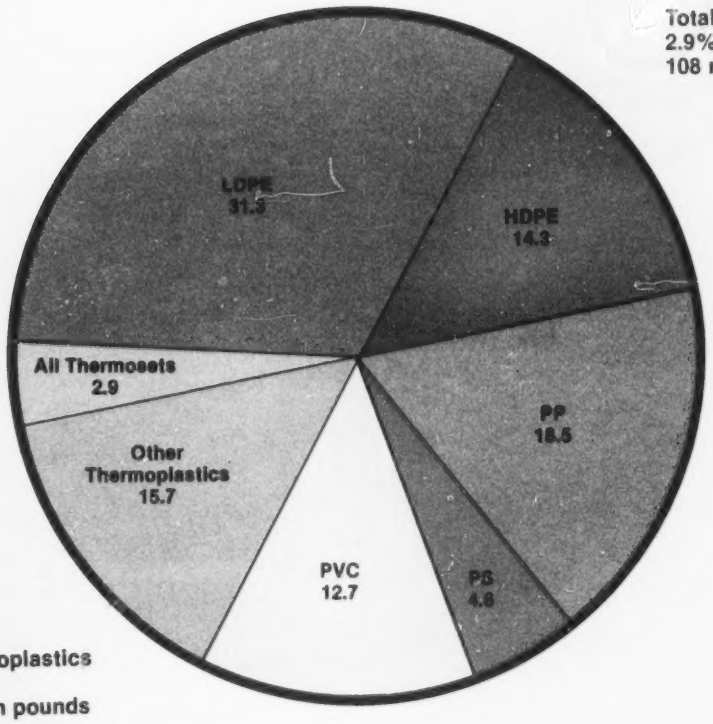


Total Thermosets
7.9%
240 million pounds

Total Thermoplastics
92.1%
2,814 million pounds

EXPORTS





Total Thermosets
2.9%
108 million pounds

Total Thermoplastics
97.1%
3,562 million pounds

APPENDIX A

Table of 1980 distribution of plastics resins sales and use by Major Market, including market segments.

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1980 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	TOTAL THERMOSETS		TOTAL THERMOPLASTICS		GRAND TOTAL (EXCLUDING POLYURETHANE FOAM)		POLYURETHANE FOAM	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	440	9.7	1,165	3.8	1,605	4.6	303	17.7
Motor Vehicles and Parts	237	5.2	1,064	3.5	1,301	3.7		
Ships, Boats and Recreational Vehicles	167	3.7	43	0.1	210	0.6		
All Other Transportation Equipment	36	0.8	58	0.2	94	0.3		
PACKAGING, TOTAL	39	0.9	9,964	32.5	10,003	28.4	57	3.3
Bottles, Jars, Vials			1,672	5.5				
Food Containers Including Disposable Cups			1,961	6.4				
Blister and Bubble Containers			135	0.4				
Flexible Packaging - (*Bags, Liners, Etc.*)			4,721	15.4				
Household and Institutional Refuse Bags & Film			2,119	6.9				
All Other Flexible Packaging			2,602	8.5				
All Other Packaging	22	0.5	1,475	4.8	1,497	4.2		
BUILDING AND CONSTRUCTION, TOTAL	2,123	46.9	4,301	14.0	6,424	18.3	317	18.5
Pipe, Conduit and Fittings	64	1.4	2,629	8.6	2,693	7.7		
Building Materials for All Structures	1,493	33.0	1,323	4.3	2,816	8.0		
Siding	386	8.6	211	0.7	597	1.7		
Flooring	389	8.6	561	1.8	950	2.7		
Insulation Materials	277	6.1	229	0.7	506	1.4		
All Other Building Materials for All Structures	441	9.7	322	1.1	763	2.2		
All Other Building and Construction	566	12.5	349	1.1	915	2.6		
ELECTRICAL / ELECTRONIC, TOTAL	273	6.0	2,180	7.1	2,453	7.0	69	4.0
Home and Industrial Appliances	101	2.2	674	2.2	775	2.2		
Communications Equipment	22	0.5	500	1.6	522	1.5		
Electric Industrial Equipment Combined with Electronic Components	150**	3.3**	1,006**	3.3**	1,073	3.1		
Storage Batteries					83	0 2		
FURNITURE AND FURNISHINGS, TOTAL	205	4.5	1,441	4.7	1,646	4.7	872	50.9
Rigid Furniture	169	3.7	106	0.3	275	0.8		
Flexible Furniture	5	0.1	33	0.1	38	0.1		
Textiles and Other Furnishings	31	0.7	1,302	4.3	1,333	3.8		
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	184	4.1	3,369	11.0	3,553	10.1	-	-
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.	28	0.7	881	2.9	909	2.5		
Health Care and Medical Products	2	0.0	485	1.6	487	1.4		
Toys and Sporting Goods	38	0.8	531	1.7	569	1.6		
Hobby and Graphic Arts Supplies	8	0.2	256	0.8	264	0.8		
All Other Consumer and Institutional Products	108	2.4	1,216	4.0	1,324	3.8		
INDUSTRIAL / MACHINERY, TOTAL	83	1.8	308	1.0	391	1.1	-	-
ADHESIVES / INKS / COATINGS, TOTAL	831	18.4	1,556	5.1	2,387	6.8	-	-
Adhesives and Sealants	186	4.1	403	1.3	589	1.7		
All Other Inks and Coatings	645	14.3	1,153	3.8	1,798	5.1		
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	240	5.3	2,814	9.2	3,054	8.6	96	5.6
Resellers and Compounders	74	1.6	1,846	6.0	1,920	5.4		
Sales Unclassified	166	3.7	968	3.2	1,134	3.2		
EXPORTS, TOTAL	108	2.4	3,562	11.6	3,670	10.4	-	-
GRAND TOTAL	4,526	100.0	30,660	100.0	35,186	100.0	1,712	100.0

** - Includes Storage Batteries

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1980 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	EPOXY		POLYESTER		UREA & MELAMINE		PHENOLICS		ALL OTHER THERMOSETS	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	261	27.5	D	D	135	8.9	D	D
Motor Vehicles and Parts			99	10.4			114	7.5		
Ships, Boats and Recreational Vehicles			140	14.8			8	0.5		
All Other Transportation Equipment			22	2.3			13	0.9		
PACKAGING, TOTAL	D	D	D	D	D	D	10	0.7	-	-
Bottles, Jars, Vials										
Food Containers Including Disposable Cups										
Blister and Bubble Containers										
Flexible Packaging - (*Bags, Liners, Etc.*)										
Household and Institutional Refuse Bags & Film										
All Other Flexible Packaging										
All Other Packaging										
BUILDING AND CONSTRUCTION, TOTAL	48	15.0	384	40.5	833	63.4	858	56.6	-	-
Pipe, Conduit and Fittings			34	3.6			11	0.7		
Building Materials for All Structures			117	12.3	581	44.2	784	51.7		
Siding							200	13.1		
Flooring							162	10.7		
Insulation Materials							277	18.3		
All Other Building Materials for All Structures					179	13.6	145	9.6		
All Other Building and Construction			233	24.6			63	4.2		
ELECTRICAL / ELECTRONIC, TOTAL	55	17.2	25	2.6	D	D	181	11.9	D	D
Home and Industrial Appliances			3	0.3			97	6.4		
Communications Equipment			3	0.3			19	1.3		
Electric Industrial Equipment Combined with Electronic Components										
Storage Batteries			19	2.0			65**	4.3**		
			-	-						
FURNITURE AND FURNISHINGS, TOTAL	-	-	26	2.7	168	12.8	11	0.7	-	-
Rigid Furniture			12	1.3						
Flexible Furniture										
Textiles and Other Furnishings										
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	-	-	100	10.5	51	3.9	33	2.2	-	-
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.										
Health Care and Medical Products										
Toys and Sporting Goods			38	4.0						
Hobby and Graphic Arts Supplies			8	0.8						
All Other Consumer and Institutional Products			52	5.5						
INDUSTRIAL / MACHINERY, TOTAL	-	-	D	D	D	D	21	1.4	D	D
ADHESIVES / INKS / COATINGS, TOTAL	150	47.0	10	1.0	99	7.5	186	12.3	386	90.2
Adhesives and Sealants	22	6.9	5	0 5			141	9.3	-	-
All Other Inks and Coatings	128	40.1	5	0.5			45	3.0	386	90.2
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	22	6.9	69	7.3	90	6.9	59	3.8	-	-
Resellers and Compounders			17	1.8			31	2.0		
Sales Unclassified			52	5.5			28	1.8		
EXPORTS, TOTAL	36	11.3	11	1.2	18	1.4	23	1.5	20	4.7
GRAND TOTAL	319	100.0	949	100.0	1 313	100.0	1.517	100.0	428	100.0

Note: Table does not add vertically or horizontally due to disclosures.

D = Disclosure

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

** - Includes Storage Batteries

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1980 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	LOW DENSISTY POLYETHYLENE		HIGH DENSISTY POLYETHYLENE		POLYPROPYLENE		ABS & SAN		POLYSTYRENE		SBL OSBL & OSBP	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	85	1.9	230	6.2	185	18.1	13	0.4	D	D
Motor Vehicles and Parts			70	1.6			172	16.9				
Ships, Boats and Recreational Vehicles												
All Other Transportation Equipment												
PACKAGING, TOTAL	4,582	61.4	2,049	46.6	720	19.4	26	2.6	1,349	38.3	D	D
Bottles, Jars, Vials	25	0.3	828	18.8	81	2.2			96	2.7		
Food Containers Including Disposable Cups	370	5.0	646	14.7	72	1.9			831	23.6		
Blister and Bubble Containers					-	-						
Flexible Packaging - (*Bags, Liners, Etc.*)	3,801	50.9	156	3.6	286	7.7			85	2.4		
Household and Institutional Refuse Bags & Film	1,807	24.2	38	0.9					-	-		
All Other Flexible Packaging	1,994	26.7	118	2.7					85	2.4		
All Other Packaging					280	7.5						
BUILDING AND CONSTRUCTION, TOTAL	186	2.5	428	9.7	D	D	234	23.0	277	7.9	D	D
Pipe, Conduit and Fittings	47	0.6	385	8.8			217	21.3	2	0.1		
Building Materials for All Structures	67	0.9							238	6.8		
Siding									-	-		
Flooring									-	-		
Insulation Materials									215	6.1		
All Other Building Materials for All Structures									23	0.7		
All Other Building and Construction	73	1.0							37	1.1		
ELECTRICAL / ELECTRONIC, TOTAL	416	5.6	167	3.8	196	5.3	265	26.0	301	8.6	D	D
Home and Industrial Appliances					89	2.4	203	19.9	217	6.2		
Communications Equipment			108	2.5								
Electric Industrial Equipment Combined with Electronic Components	254	3.4										
Storage Batteries	-	-	-	-								
FURNITURE AND FURNISHINGS, TOTAL	15	0.2	D	D	727	19.6	8	0.8	74	2.1	309	39.1
Rigid Furniture							7	0.7	50	1.4	-	-
Flexible Furniture												
Textiles and Other Furnishings					706	19.0						
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	570	7.6	495	11.3	505	13.6	93	9.1	779	22.1	7	0.9
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.	176	2.4	213	4.8	122	3.3	25	2.4	282	8.0		
Health Care and Medical Products	120	1.6	31	0.7	143	3.9	10	1.0	93	2.6		
Toys and Sporting Goods	88	1.2	95	2.2	43	1.2	18	1.8	203	5.8		
Hobby and Graphic Arts Supplies			-	-			7	0.7	61	1.7		
All Other Consumer and Institutional Products			156	3.6			33	3.2	140	4.0		
INDUSTRIAL / MACHINERY, TOTAL	D	D	D	D	52	1.4	13	1.3	D	D	D	D
ADHESIVES / INKS / COATINGS, TOTAL	D	D	-	-	D	D	-	-	D	D	D	D
Adhesives and Sealants												
All Other Inks and Coatings												
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	464	6.2	536	12.2	580	15.6	125	12.3	539	15.3	66	8.4
Resellers and Compounders	333	4.5	428	9.7	420	11.3			293	8.3		
Sales Unclassified	131	1.7	108	2.5	160	4.3			246	7.0		
EXPORTS, TOTAL	1,147	15.4	526	12.0	680	18.3	69	6.8	168	4.8	41	5.2
GRAND TOTAL	7,467	100.0	4,394	100.0	3,714	100.0	1,019	100.0	3,518	100.0	790	100.0

Note: Table does not add vertically or horizontally due to disclosure.

D = Disclosure

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1980 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	NYLON		POLYVINYL CHLORIDE		PVAc, PVA & OTHER VINYL RESINS		THERMOPLASTIC POLYESTER		ALL OTHER THERMOPLASTICS	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	81	29.9	195	3.6	D	D	16	3.1	244	9.6
Motor Vehicles and Parts			180	3.3					209	8.2
Ships, Boats and Recreational Vehicles									4	0.2
All Other Transportation Equipment							-	-	31	1.2
PACKAGING, TOTAL	28	10.3	410	7.5	D	D	407	79.6	293	11.5
Bottles, Jars, Vials			101	1.9					153	6.0
Food Containers Including Disposable Cups			12	0.2						
Blister and Bubble Containers			55	1.0						
Flexible Packaging - *(Bags, Liners, Etc.)*	17	6.3	209	3.8					82	3.2
Household and Institutional Refuse Bags & Film			180	3.3						
All Other Flexible Packaging	17	6.3	29	0.5						
All Other Packaging			33	0.6					6	0.2
BUILDING AND CONSTRUCTION, TOTAL	D	D	2,690	49.8	25	2.4	D	D	428	16.8
Pipe, Conduit and Fittings			1,953	36.1					13	0.5
Building Materials for All Structures			658	12.2					299	11.7
Siding			194	3.6						
Flooring			300	5.5					257	10.1
Insulation Materials			14	0.3						
All Other Building Materials for All Structures			150	2.8						
All Other Building and Construction			79	1.5					115	4.5
ELECTRICAL / ELECTRONIC, TOTAL	53	19.6	539	10.0	D	D	26	5.1	213	8.4
Home and Industrial Appliances	15	5.5	31	0.6			5	1.0	80	3.1
Communications Equipment	3	1.1	81	1.5			2	0.4		
Electric Industrial Equipment Combined with Electronic Components	35	12.9	427**	7.9 **			19	3.7		
Storage Batteries	-	-					-	-		
FURNITURE AND FURNISHINGS, TOTAL	8	3.0	216	4.0	49	4.8	D	D	15	0.6
Rigid Furniture			9	0.1						
Flexible Furniture			14	0.3						
Textiles and Other Furnishings			193	3.6						
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	17	6.3	427	7.9	88	8.6	8	1.6	380	14.9
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.									14	0.5
Health Care and Medical Products	3	1.1	42	0.8					22	0.9
Toys and Sporting Goods	3	1.1	71	1.3					10	0.4
Hobby and Graphic Arts Supplies									163	6.4
All Other Consumer and Institutional Products	8	3.0	302	5.6					171	6.7
INDUSTRIAL / MACHINERY, TOTAL	20	7.4	16	0.3	-	-	D	D	42	1.6
ADHESIVES / INKS / COATINGS, TOTAL	D	D	79	1.5	650	63.6	D	D	500	19.6
Adhesives and Sealants			36	0.7	305	29.8			-	-
All Other Inks and Coatings			43	0.8	345	33.8			500	19.6
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	28	10.3	370	6.8	D	D	D	D	90	3.6
Resellers and Compounders	20	7.4	200	3.7					73	2.9
Sales Unclassified	8	2.9	170	3.1					17	0.7
EXPORTS, TOTAL	23	8.5	465	8.6	70	6.8	31	6.1	342	13.4
GRAND TOTAL	271	100.0	5,407	100.0	1,022	100.0	511	100.0	2,547	100.0

Note: Table does not add vertically or horizontally due to disclosure.

D = Disclosure SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

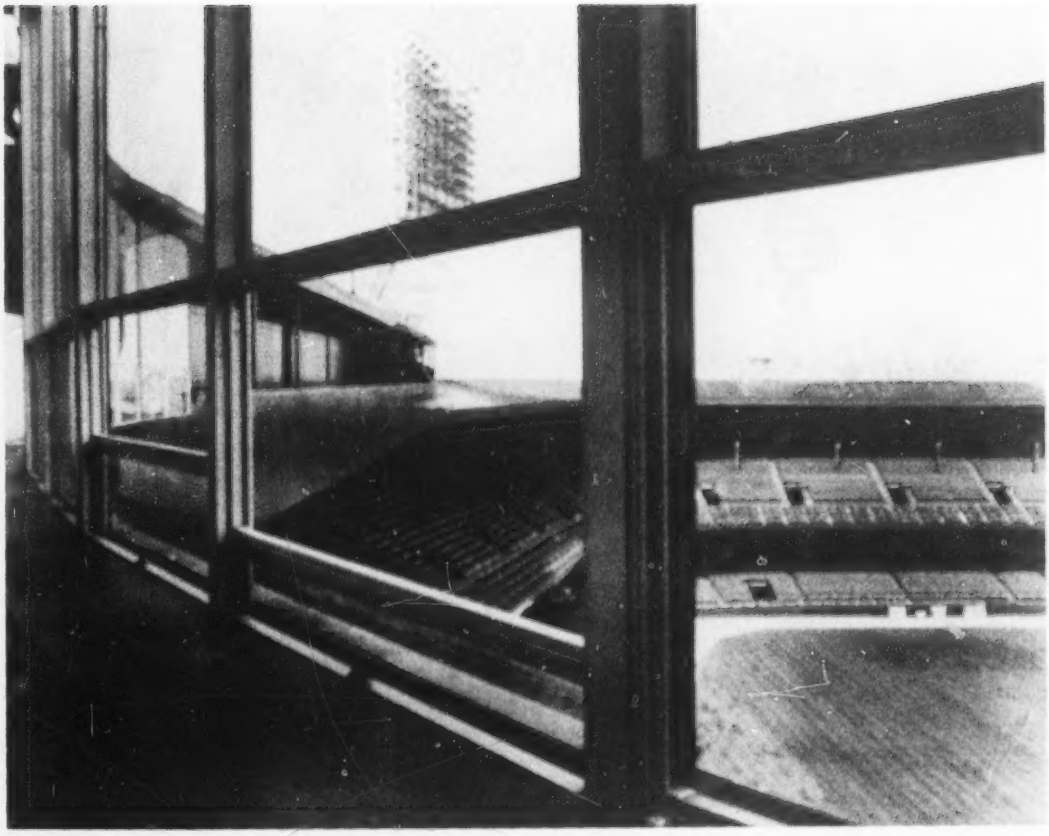
** Includes Storage Batteries

APPENDIX B

DISTRIBUTION OF POLYURETHANE FOAM SALES AND USE BY MAJOR MARKET

(in millions of pounds)

	Quantity				% of Total			
	1977	1978	1979	1980	1977	1978	1979	1980
Transportation	457	466	418	288	24.6%	23.8%	21.7%	16.8%
Flexible	383	390	367	242	20.6	19.9	19.0	14.1
Rigid	74	76	51	46	4.0	3.9	2.7	2.7
Packaging	49	57	62	57	2.6	2.9	3.2	3.3
Flexible	28	33	31	23	1.5	1.7	1.6	1.3
Rigid	21	24	31	34	1.1	1.2	1.6	2.0
Furniture/Furnishings	951	980	973	872	51.2	50.0	50.4	50.9
Flexible	919	947	948	850	49.5	48.3	49.1	49.7
Rigid	32	33	25	22	1.7	1.7	1.3	1.2
Building/Construction	236	283	322	315	12.7	14.4	16.7	18.4
Electrical/Electronic	81	79	84	69	4.4	4.0	4.4	4.1
All Other	83	96	71	111	4.5	4.9	3.6	6.5
Total	1,857	1,961	1,930	1,712	100.0%	100.0%	100.0%	100.0%



Direct hits can't damage the windows in the press box at Detroit's Tiger Stadium. Installed after a fire necessitated a major renovation, the sheet provides excellent visibility, protects broadcasters and sportswriters from the elements, and stands up to numerous foul balls during a season.

Courtesy: Plastics World Magazine/General Electric Plastics

PROCESSING & MACHINERY

PROCESSING METHODS

INJECTION MOLDING

Injection molding is the principal method of forming thermoplastic materials. Modifications of the injection process are sometimes used for thermosetting plastics.

In injection molding, plastic material is put into a hopper which feeds into a heating chamber. A plunger pushes the plastic through this long heating chamber where the material is softened to a fluid state. At the end of this chamber there is a nozzle which abuts firmly against an opening into a cool, closed mold. The fluid plastic is forced at high pressure through this nozzle into the cold mold. As soon as the plastic cools to a solid state, the mold opens and the finished plastic is ejected from the press.

The problem with injection molding of thermosetting materials is that, under heat, these plastics will first soften, then harden to an infusible state. Thus it is essential that no softened thermosetting material in the heating chamber be allowed to remain there long enough to set.

Jet molding, offset molding and molding using a screw-type machine overcome this problem by liquefying the thermosetting plastic material just as it goes through the injection nozzle into the mold, but not before.

BLOW MOLDING

Blow molding is a method of forming used with thermoplastic materials.

Basically, blow molding consists of stretching and then hardening a plastic against a mold. There are two general methods of doing this type of thermoplastic molding: the direct method and the indirect method, encompassing several variations of each.

In the direct method, a gob of molten thermoplastic material is formed into the rough shape of the desired finished product. This shape is then inserted in a female mold and air blown into the plastic, as into a balloon, to force it against the sides of the mold. The formed material is then cooled before removal from the mold.

In the indirect method, a thermoplastic sheet or special shape is first heated, then clamped between a die and cover. Air pressure forced between the plastic and the cover forces the material into contact with the die, which has the contour desired in the finished product. The plastic is cooled before removal from contact with the die.

COMPRESSION MOLDING

Compression molding is the most common method of forming thermosetting materials. It is not generally used for thermoplastics.

Compression molding is simply the squeezing of a material into a desired shape by application of heat and pressure to the material in a mold.

Plastic molding powder, mixed with such materials or fillers as woodflour, cellulose and asbestos to strengthen or give other added qualities to the finished product, is put directly into the open mold cavity. The mold is then closed, pressing down on the plastic and causing it to flow throughout the mold. It is while the heated mold is closed that the thermosetting material undergoes a chemical change which permanently hardens it into the shape of the mold. The three compression molding factors—pressure, temperature and time mold is closed—vary with the design of the finished article and the material being molded.

EXTRUSION

Extrusion molding is the method employed to form thermoplastic materials into continuous sheeting, film, tubes, rods, profile shapes, filaments, and to coat wire, cable and cord.

In extrusion, dry plastic material is first loaded into a hopper, then fed into a long heating chamber through which it is moved by the action of a continuously revolving screw. At the end of the heating chamber the molten plastic is forced out through a small opening or die with the shape

desired in the finished product. As the plastic extrusion comes from the die, it is fed onto a conveyor belt where it is cooled, most frequently by blowers or by immersion in water.

In the case of wire and cable coating, the thermoplastic is extruded around a continuing length of wire or cable which, like the plastic, passes through the extruder die. The coated wire is wound on drums after cooling.

In producing wide film or sheeting, the plastic is extruded in the form of a tube. This tube may be split as it comes from the die and then stretched and thinned to the dimensions desired in the finished film.

In a different process, the extruded tubing is inflated as it comes from the die, the degree of inflation of the tubing regulating the thickness of the final film.

THERMOFORMING

Thermoforming of plastic sheet has developed rapidly in recent years. Basically, this process consists of heating thermoplastic sheet to a formable plastic state and then applying air and/or mechanical assists to shape it to the contours of a mold.

Air pressure may range from almost zero to several hundred psi. Up to approximately 14 psi (atmospheric pressure), the pressure is obtained by evacuating the space between the sheet and the mold in order to utilize this atmospheric pressure. This range, known as *vacuum forming,* will give satisfactory reproduction of the mold configuration in the majority of forming applications.

TRANSFER MOLDING

Transfer molding is most generally used for thermosetting plastics.

This method is like compression molding in that the plastic is cured into an infusible state in a mold under heat and pressure. It differs from compression molding in that the plastic is heated to a point of plasticity before it reaches the mold and is forced into a closed mold by means of an hydraulically-operated plunger.

Transfer molding was developed to facilitate the molding of intricate products with small deep holes or numerous metal inserts. The dry molding compound used in compression molding sometimes disturbs the position of the metal inserts and the pins which form the holes. The liquefied plastic material in transfer molding flows around these metal parts without causing them to shift position.

REACTION INJECTION MOLDING

Reaction injection molding (RIM) is a relatively new processing technique that has rapidly taken its place alongside more traditional methods. Unlike liquid casting, the two liquid components, polyols and isocyanates, are mixed in a chamber at relatively low temperatures (75°-140°F) before injection into a closed mold. An exothermic reaction occurs and consequently RIM requires far less energy usage than any other injection molding system.

The three major types of polyurethane RIM systems are rigid structural foam, low-modulus elastomers, and high-modulus elastomers.

Reinforced RIM (R-RIM) consists in the addition of such materials as chopped or milled glass fiber to the polyurethane to enhance stiffness and to increase modulus thus expanding the range of applications.

DOLLAR SALES OF PLASTICS MACHINERY[a]
(in millions of dollars)

Machine Type	1975	1976	1977	1978	1979[r]	1980
Injection Molding	110.6	247.6	290.1	323.0	352.2	296.7
Structural Foam	4.2	4.1	8.5	9.5	10.6	11.7
Extrusion, single screw	85.3	81.3	91.6	102.0	195.7	226.5
Extrusion, multi screw	11.3	21.8	24.2	28.0	27.3	25.9
Blow Molding	25.7	25.4	51.1	81.0	91.0	100.0
Thermoforming	15.4	24.3	22.0	22.9	25.0	26.2
Reaction-Injection Molding	—	3.9	3.9	5.2	5.2	6.7
Compression	13.7	24.3	23.2	25.0	27.5	24.2
Foam Molding	1.8	2.1	3.0	3.5	15.0	14.8
Transfer Molding	5.8	5.9	6.6	7.3	7.8	8.1
Total	273.8	440.7	524.2	607.4	757.3	740.8

SHIPMENTS OF PLASTICS MACHINERY BY TYPE
(in number of units)

Year	Injection	Blow Molding	Transfer	Compression	Foam[c]	Thermo-forming[c]	Extruders (Single screw)	Extruders (Multi screw)	Structural Foam
1976	2,710	254	208	681	89	813	1,076	137	18
1977	3,341	154[b]	146	476	111	1,148	1,077	149	34
1978	3,782	360	152	563	120	1,192	1,411	145	48
1979	3,690	425	154	586	207	525	1,500	136	51
1980	2,580	447	143	514	160	515	1,399	116	49

BLOW MOLDING			REACTION-INJECTION MOLDING/CLAMPS
Year	Domestic	Exports	Domestic & Exports
1976	235	19	53
1977	140[b]	14[b]	80
1978	327	33	72
1979	367	58	97
1980	359	88	155

[b] = Extrusion-blow units only

[a] Includes value of machinery not shown in the tables below.

[c] Data base revised in 1979

r = Revised from 1980 edition.

Source: Domestic and export shipments of injection molding and extruders—The Society of the Plastics Industry supplemented by *Modern Plastics Annual Machinery Sales Survey.* All other figures *Modern Plastics.*

STRUCTURAL FOAM		
Year	Domestic	Exports
1976	18	—
1977	34	—
1978	48	—
1979	47	4
1980	43	6

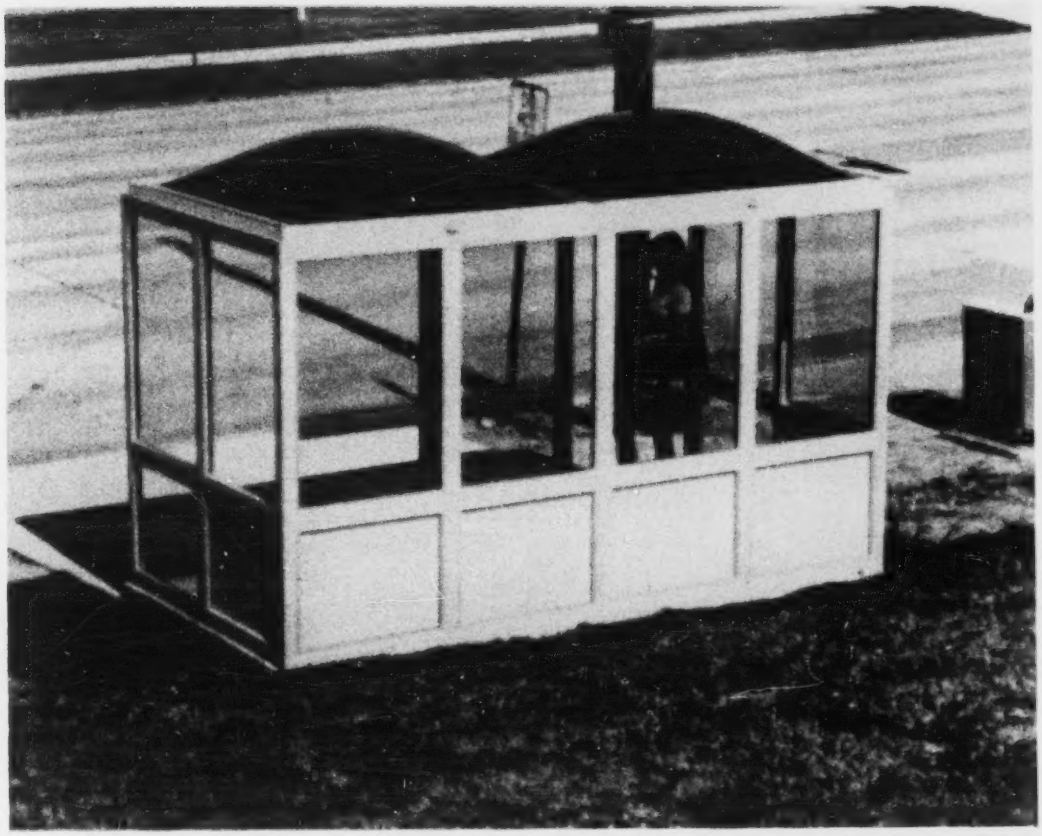
THERMOSET TRANSFER & INJECTION-TRANSFER MOLDING		
Year	Domestic	Exports
1976	157	51
1977	127	19
1978	131	21
1979	140	14
1980	124	19

THERMOFORMING[c]	
Domestic	Exports
728	85
1,004	144
1,053	139
464	61
434	81

FOAM MOLDING[c] (EXPANDED BEAD)		
Year	Domestic	Exports
1976	66	23
1977	99	12
1978	106	14
1979	180	27
1980	131	29

COMPRESSION MOLDING	
Domestic	Exports
643	38
443	33
538	25
553	23
487	27

[c]Data base revised in 1979
Source: *Modern Plastics*



Tough, weather-resistant plastic sheet forms a high-strength roof for this passenger transit shelter.
Courtesy: Plastics World Magazine/Eastman Chemical Products

PLASTICS TRADE NAMES

The following list of tradenames in alphabetic order and the cross-index by type of resin were gathered from various sources. SPI has done its best to verify all listings and incorporate all known plastics resins. Any errors or omissions should be directed to the Statistical Department of SPI.

Absafil	Fiberglass-reinforced ABS	Dart Industries, Inc.
Absaglas	Fiberglass-reinforced ABS	Dart Industries, Inc.
Absasar	Fiberglass-reinforced ABS	Dart Industries, Inc.
Abson	ABS; ABS/PVC	Abtec Chemical Co.
Accobond	Cellulosic film resins	American Cyanamid Co.
Aclon	Polychlorotrifluoroethylene (CTFE)	Allied Corp.
Acralen	Ethylene-vinyl acetate polymer	Mobay Chemical Co.
Acralen	Styrene-butadiene latex	Mobay Chemical Co.
Acrylacon	Acrylonitrile-styrene-fiberglass	Dart Industries, Inc.
Acrylafil	Reinforced SAN	Dart Industries, Inc.
Acrylaglas	Fiberglass-reinforced SAN	Dart Industries, Inc.
Acrylasar	Fiberglass-reinforced SAN	Dart Industries, Inc.
Acrylite	Methyl methacrylate for molding & extrusion	CY/RO Co.
Acrysol	Water soluble acrylic resins	Rohm and Haas Co.
Adlock	High impact phenolic molding compounds	Furane Plastics, Inc.
Admino	Melamine-formaldehyde	Ashland Chemical Co.
Adtac	Hydrocarbon resin	Hercules Incorporated
Aerodux	Resorcinol-formaldehyde	Ciba-Geigy Corp.
Aeroglas	Thermosetting resins	American Cyanamid Co.
Aerolite	Urea-formaldehyde	Ciba-Geigy Corp.
A-Fax	Amorphous polypropylene	Hercules Incorporated
Airflex	Vinyl acetate-ethylene copolymer	Air Products & Chemicals Co.
Alathon	Polyethylene	DuPont Co.
Alftalat (series)	Alkyd resins	American Hoechst Corp.
Alkydal	Alkyd resins	Mobay Chemical Co.
Alpolit	Unsaturated polyester resin	American Hoechst Corp.
Alprodur	Chlorinated polypropylene	American Hoechst Corp.
Amberlyst	Ion exchange resins	Rohm and Haas Co.
Amberol	Phenolic resins	Rohm and Haas Co.
Amres	Phenolic, urea & melamine resins	Pacific Resins & Chem.
Aquace	Vinyl acetate-ethylene copolymer emulsions	Hercules Incorporated
Araldite	Epoxy cast resins	Ciba-Geigy Corp.
Aramidyl	Polyamide-imide resin	Westinghouse Electric
Ardel	Polyarylate	Union Carbide Corp.
Aroflat	Alkyd resins	Spencer Kellogg
Aroflint	Polyester-epoxy resins	Spencer Kellogg
Aroplaz	Alkyd resins	Spencer Kellogg
Aropol	Polyester & alkyd molding material	Ashland Chemical Co.
Aroset	Thermosetting acrylic resins	Ashland Chemical Co.
Arylon T	ABS/polysulfone	USS Chemical Div.
Astrel-360	Polyaryl sulfone	3M Co.
Astroloy	Polyester resin	Reichhold Chemical, Inc.
Atlac	Polyester cast resin	ICI Americas Inc.
Avisco	Melamine-formaldehyde molding compounds	FMC Corp.
Avi-sun	Polypropylene	Amoco Chemical Corp.
Azamide	Polyamide	AZ Products Co.
AZ rez	Polyester	AZ Products Co.
Bakelite	Polyethylene, epoxy, EVA, phenoxy, phenolic, vinyl	Union Carbide Corp.
Barex	Nitrile resins	Vistron Corp.
Barex 210	Nitrile resins	Vistron Corp.
Beckipox EP	Unmodified biphenol based epoxy	American Hoechst Corp.
Beckopol	High modified phenolic resins	Reichhold Chemicals, Inc.
Beckosol	Alkyd resins	Reichhold Chemicals, Inc.
BiPak	Biaxially oriented polystyrene	A & E Plastik Pak
Blendex	ABS resin	Borg Warner Corp.
Butacite	Polyvinyl butyral resins	DuPont Co.
Butaprene	Styrene-butadiene latices	Firestone Plastics Co.
Butafan	Styrene-butadiene copolymers	BASF Wyandotte Corp.
Butvar	Polyvinyl butyral resins	Monsanto Co.
Capron	Nylon 6 polymers & copolymers	Allied Corp.
Carbaglas	Fiberglass-reinforced polycarbonate	Dart Industries, Inc.
Carbasar	Fiberglass-reinforced polycarbonate	Dart Industries, Inc.
Carbopol	Water-soluble resins	B.F. Goodrich Chemical
Carboset	Acrylic resins	B.F. Goodrich Chemical
Cardolite	Epoxy cast resins	3M Co.
Cascamite	Urea-formaldehyde	Borden, Inc.
Cascomel	Melamine-formaldehyde	Borden, Inc.
Cascophen	Phenol-formaldehyde	Borden, Inc.
Casco Resin	Urea-formaldehyde	Borden, Inc.
Cascorez	Polyvinyl acetate	Borden, Inc.
Castastock	Phenol-formaldehyde	Ashland Chemical Co.
Catabox	Urea-formaldehyde	Ashland Chemical Co.
Catacol	Phenol-formaldehyde	Ashland Chemical Co.
Catacore	Phenol-formaldehyde	Ashland Chemical Co.
Catacote	Phenol-formaldehyde	Ashland Chemical Co.
Catadec	Melamine-formaldehyde prepreg	Ashland Chemical Co.

Catafilm	Phenol-formaldehyde	Ashland Chemical Co.
Cataform	Phenol-formaldehyde	Ashland Chemical Co.
Catalac	Phenol-formaldehyde	Ashland Chemical Co.
Catalin	Synthetic resins	Ashland Chemical Co.
Celanex	Thermoplastic polyester	Celanese Plastics & Specialties Co.
Celca Cet	Polyvinyl acetate homo & copolymers	Celanese Plastics & Specialties Co.
Celca Cril	Acrylics	Celanese Plastics & Specialties Co.
Celcon	Acetal copolymer	Celanese Plastics & Specialties Co.
Cerex	Polystyrene	Monsanto Co.
Chempol	Alkyd resins	Freeman Chemical Corp.
Cleartuf	Polybutylene terephthalate bottle resin	Goodyear Tire & Rubber Co.
Concord	Epoxy products	Morton Chemical Co.
Copon	Epoxy compounds, polyamides	Reliance Universal, Inc.
CoRezyn	Polyester resins	Interplastic Corp.
Corrolite	Vinyl ester resin	Reichhold Chemicals, Inc.
Crystalex	Acrylic	Rohm and Haas Co.
Cumar	Coumarone-indene resins	Neville Chemical Co.
Cycolac	ABS resin	Borg Warner Corp.
Cycolon	ABS resin	Borg Warner Corp.
Cycoloy	ABS resin	Borg Warner Corp.
Cycopac	ABS resin	Borg Warner Corp.
Cycovin	ABS resin	Borg Warner Corp.
Cyglas	Glass filled polyester molding compound	American Cyanamid Co.
Cymac	Thermoplastic molding materials	American Cyanamid Co.
Cymel	Melamine molding compound	American Cyanamid Co.
Cypor	Polyester resin	American Cyanamid Co.
Dacovin	PVC compounds	Diamond Shamrock Corp.
Dapex	Diallyl phthalate	Acme Resin Co.
Dapon	Diallyl phthalate prepolymer	FMC Corp.
Darafiber	Styrene-butadiene latices	W.R. Grace & Co.
Daran	Polyvinylidene chloride emulsion coatings	W.R. Grace & Co.
Daratak	Polyvinyl acetate homopolymer emulsions	W.R. Grace & Co.
Darex	Polyvinyl acetate emulsion, high styrene copolymer latex, high styrene copolymer resin	W.R. Grace & Co.
Decoloy	Acrylic-ABS composite	Borg Warner Corp.
D.E.H.	Epoxy curing agent	Dow Chemical Co.
Delrin	Acetal homopolymer	DuPont Co.
D.E.N.	Epoxy novolac	Dow Chemical Co.
Der	Epoxy extrusion & molding compounds	Dow Chemical Co.
Derakane	Vinyl-ester resins	Dow Chemical Co.
Derolite	Ion exchange resin	Diamond Shamrock Corp.
Diall	Diallyl phthalate molding compound	Allied Corp.
Dion	Polyester resin	Koppers Company
Dion Cor-Res	Corrosion-resistant polyesters	Koppers Company
Dion FR	Fire retardant polyesters	Koppers Company
Dion-Iso	Isophthalic polyester	Koppers Company
Diorid	Polyvinylidene chloride	Tenneco Chemical, Inc.
Dowex	Ion exchange resin	Dow Chemical Co.
Duolite	Ion exchange resin	Diamond Shamrock Corp.
Duraplex	Alkyd resins	Rohm and Haas Co.
Durez	Phenolic & other thermosets	Hooker Chem. & Plastics
Durite	Phenol-formaldehyde	Borden, Inc.
Durophen	Plasticized phenolic resin	American Hoechst Corp.
Dylark	Styrene-based polymer	ARCO/Polymers, Inc.
Dylel	ABS resin	ARCO/Polymers, Inc.
Dylene	Polystyrene resin	ARCO/Polymers, Inc.
Dylex	Copolymer styrene-butadiene latex	ARCO/Polymers, Inc.
Dylite	Expandable polystyrene beads	ARCO/Polymers, Inc.
Dymetrol	Nylon monofilaments	DuPont Co.
Dyphene	Phenol-formaldehyde resins	Sherwin-Williams Co.
Dyphenite	Phenol-formaldehyde resins	Sherwin-Williams Co.
Dypol	Polyester resins	Sherwin-Williams Co.
Dypro	Polypropylene	ARCO/Polymers, Inc.
Ektar	Thermoplastic polyester	Eastman Chemical Products
El Rex	Polyolefin resins	Dart Industries, Inc.
El Rexene	Thermoplastic resins	Dart Industries, Inc.
El Rey	Low density polyethylene	Dart Industries, Inc.
Eltex	High density polyethylene	Soltex Polymer Corp.
Elvace	Ethylene-acetate copolymer emulsions	DuPont Co.
Elvacite	Acrylic resin	DuPont Co.
Elvamide	Nylon resins	DuPont Co.
Elvanol	Polyvinyl alcohol resins	DuPont Co.
Elvax	Resins	DuPont Co.
Envex	Thermoplastic polyimide	DuPont Co.
Epiall	Epoxy molding compound	Rogers Corp.
Epiclon	Epoxy resins	Allied Corp.
Epi-Cure	Epoxy cast resin	Celanese Plastics & Specialties Co.
Epi-Rez	Epoxy resin	Celanese Plastics & Specialties Co.
Epi-Tex	Epoxy ester resins	Celanese Plastics & Specialties Co.
Epocryl	Epoxy acrylate & methacrylate resins	Celanese Plastics & Specialties Co.
Epon	Epoxy cast resin	Shell Chemical Co.
Eponol	Thermoplastic epoxy resins	Shell Chemical Co.
		Shell Chemical Co.

Epotuf	Epoxy resins	Reichhold Chemical Co.
Epoxin	Epoxy resins	BASF Wyandotte Corp.
Ertalon	Nylon 11, 6, 6/6 extrusion & molding compounds	Chemplast, Inc.
Ethafoam	Plastic foam	Dow Chemical Co.
Ethocel	Ethyl cellulose resins	Dow Chemical Co.
Ethosar	Fiberglass-reinforced polyethylene	Dart Industries, Inc.
Ethron	Polyethylene resin	Dow Chemical Co.
Evenglo	Polystyrene resin	ARCO/Polymer, Inc.
Everflex	Polyvinyl acetate copolymer emulsion	W.R. Grace & Co.
Exon	PVC resins	Firestone Plastics Co.
E-Z Flow	Polystyrene	Polysar Resin, Inc.
Fabrez	Urea-formaldehyde resins	Reichhold Chemicals, Inc.
Felor	Nylon 6/6 copolymer filaments	DuPont Co.
Flexbond	Polyvinyl acetate copolymer	Air Products & Chemicals
Flexiplast	Polyvinyl acetate	American Hoechst Corp.
Fluon	Polytetrafluoroethylene resins	ICI Americas Inc.
Fluorolene	Polytetrafluoroethylene	LNP Corp.
Fluororing	TFE molding compound	LNP Corp.
Forar	Polystyrene	Amoco Chemicals Corp.
Formaldafil	Reinforced acetal	Dart Industries, Inc.
Formaldaglas	Fiberglass-reinforced acetal	Dart Industries, Inc.
Formaldasar	Fiberglass-reinforced acetal	Dart Industries, Inc.
Formvar	Polyvinyl formal resins	Monsanto Co.
Fortiflex	Polyethylene resins	Soltex Polymer Corp.
Fortilene	Polypropylene	Soltex Polymer Corp.
Fosta	Nylon 6 resins	American Hoechst Corp.
Fostafoam	Foamed polystyrene board	American Hoechst Corp.
Fostalite	Polystyrene, light-stable	American Hoechst Corp.
Fostarene	Polystyrene resins & molding compounds	American Hoechst Corp.
Fosta Tuf-Flex	High impact polystyrene resins	American Hoechst Corp.
Fostercast	Polyester cast resin	Westinghouse Electric Co.
Fosterite	Polyester impregnating & encapsulating materials	Westinghouse Electric Co.
Foundrez	Urea-formaldehyde, phenol-formaldehyde	Reichhold Chemicals, Inc.
Fporka	Urea-formaldehyde	BASF Wyandotte Corp.
Gafite	Polybutylene terephthalate	GAF Corp.
Gantrez	Polymethyl, polyvinyl, polyether, copolymers	GAF Corp.
Gelva	Polyvinyl acetate resins	Monsanto Co.
Gelvatol	Polyvinyl alcohol resins	Monsanto Co.
Gemon	Glass-reinforced polyimide	General Electric Co.
Genal	Phenolic	General Electric Co.
Genclor	Chlorinated PVC	ICI Americas Inc.
Genetron plastic	Polychlorotrifluoroethylene, modified	Allied Corp.
Gen-Flo	Styrene butadiene latex	General Tire & Rubber Co.
Genite	Glass-reinforced polyester	General Tire & Rubber Co.
Genpol	Polyester resin	General Tire & Rubber Co.
Gentron	Fluorinated hydrocarbon polymers	Allied Corp.
Geon	PVC amd copolymers	B.F. Goodrich Chemical Co.
Glasfloss	Phenolic-impregnated glass fibers	Hooker Chemicals & Plastics
Glaskyd	Glass-reinforced alkyd molding compounds	American Cyanamid Co.
Glidpol	Polyester cast resin	Glidden Co.
Glykon	Polyester resin	General Tire & Rubber Co.
Halar	Ethylene-chlorotrifluoroethylene copolymer	Allied Corp.
Hercocel	Polypropylene expandable pellets	Hercules Incorporated
Hercose	Cellulose acetate propionate	Hercules Incorporated
Hercoset	Polyamide epichlorohydrin resin	Hercules Incorporated
Herox	Nylon 66 filaments	DuPont Co.
Hetron	Polyester & furan resins	Ashland Chemical Co.
Hex One	High density polyethylene copolymers	Gulf Oil Chemicals Co.
Hi-fax	High density polyethylene	Hercules Incorporated
Hi Temp Geon	Chlorinated PVC	B. F. Goodrich Chemical
Hostaflon	Fluorine resin, fluoroethylene resins; polytetrafluoroethylene	American Hoechst Corp.
Hostalen	Polyethylene resin compound, polypropylene	American Hoechst Corp.
Hostaphan	PVC emulsion and suspension material	American Hoechst Corp.
Hotbac	Resins	DuPont Co.
Hycar	Polyacrylic ester; phenol-formaldehyde	B.F. Goodrich Chemical
Hydantoin	Epoxies	Ciba-Geigy Corp.
Implex	High impact acrylic resins & molding compounds	Rohm and Haas Co.
Intamix	Rigid PVC compounds	Diamond Shamrock Corp.
Irvinil	PVC	Great American Chemical Co.
Isolite	Polyester resin	Schenectady Chemicals, Inc.
Jet Flow	Polystyrene	Polysar Resin, Inc.
Kastor Acrylon	Phenol-formaldehyde	Borden, Inc.
Kauramin	Melamine resin	BASF Wyandotte Corp.
Kauresin	Phenol-formaldehyde resins	BASF Wyandotte Corp.
Kaurit	Urea-formaldehyde resin	BASF Wyandotte Corp.
Kelkyd	Alkyd resin	Textron, Inc.
Klucel	Hydroxypropyl cellulose	Hercules, Incoporated
Kohinoor	PVC resins & compounds	Pantasote Co.
Koplac	Polyester resins	ARCO/Polymers, Inc.
Kopox	Epoxy resin	ARCO/Polymers, Inc.
Kopoxite	Epoxy resin	ARCO/Polymers, Inc.
Kralastic	High impact ABS	USS Chemicals Div.
K-Resin	Butadiene styrene	Phillips Chemical Co.

Kriston	Allyl ester casting resins	B. F. Goodrich Chemical Co.
Krylene	Styrene butadiene	Polysar Resins, Inc.
Krymix	Styrene butadiene	Polysar Resins, Inc.
Krynac	Acrylonitrile butadiene	Polysar Resins, Inc.
Krynol	Styrene butadiene	Polysar Resins, Inc.
Kurofan	Polyvinylidene chloride dispersions	BASF Wyandotte Corp.
Kynar	Polyvinylidene fluoride	Pennwalt Corp.
Lemac	Polyvinyl acetate	Borden, Inc.
Lemol	Polyvinyl alcohol	Borden, Inc.
Le Rexene	Polypropylene copolymer	Dart Industries, Inc.
Levapren	Polyethylene-vinyl acetate copolymers	Mobay Chemical Corp.
Lexan (series)	Polycarbonate resins	General Electric Co.
Lucite	Acrylic resin; methyl methacrylate	DuPont Co.
Luparen	Polypropylene	BASF Wyandotte Corp.
Lupolen	Polyethylene	BASF Wyandotte Corp.
Luran	ABS	BASF Wyandotte Corp.
Luran S.	ASA terpolymer	BASF Wyandotte Corp.
Lustran	SAN & ABS molding & extrusion resins	Monsanto Co.
Lustrex	Polystyrene molding & extrusion resins	Monsanto Co.
Lutrex	Polyvinyl acetate	American Hoechst Corp.
Lutrigen	Chlorinated polyethylene	BASF Wyandotte Corp.
Luvipol	Melamine-formaldehyde resin	BASF Wyandotte Corp.
Luvitherm	PVC	BASF Wyandotte Corp.
Lytron	Styrene & Styrene copolymer latexes	Monsanto Co.
Makrofol	Polycarbonates	Mobay Chemical Corp.
Marbon	ABS resins	Borg Warner Chemicals
Marlex (series)	Polyolefin resins & molding compounds	Phillips Chemical Co.
Melmac	Melamine-formaldehyde molding compound	American Cyanamid Co.
Meltron	Melamine-formaldehyde resins	Bostik South, Inc.
Merlon	Polycarbonates	Mobay Chemical Corp.
Mersize	Fortified rosin-based size	Monsanto Co.
Micro-Black	Styrene butadiene	B.F. Goodrich Chemical Co.
Microthene	Powdered polyethylene resins	U.S. Industrial Chemicals
Milvex	Polyamide resins	Henkel Corp.
Minlon	Mineral-reinforced nylon resin	DuPont Co.
Moleculoy	Nylon & linear polyamide polymers	Belding Chemical
Monobed	Ion exchange resins	Rohm and Haas Co.
Monsize	Paper sizing agent	Monsanto Co.
Moplen	Polypropylene	USS Novamont Corp.
Moviol	Polyvinyl alcohol	American Hoechst Corp.
MR/Marco	Polyester resins	USS Chemicals Div.
Multron	Polyesters	Mobay Chemical Corp.
Natrusol	Hydroxyethyl cellulose	Hercules Incorporated
Naugatex	Butradiene styrene latices	USS Chemicals Div.
Nebony	Petroleum hydrocarbon resin	Neville Chemical Co.
Neochem	Hydrocarbon resin	Neville Chemical Co.
Neocryl	Acrylic resins	Polyvinyl Chemicals
Nevilloid	Coumarone-indene resin emulsion	Neville Chemical Co.
Nevindene	Coumarone-indene resin	Neville Chemical Co.
Nevoxy	Hydrocarbon resin	Neville Chemical Co.
Nevpene	Hydrocarbon resin	Neville Chemical Co.
Nevroz	Hydrocarbon resin	Neville Chemical Co.
Noan	Styrene-methylmethacrylate copolymer	Richardson Co.
Norchem	Low density polyethylene & polypropylene	Northern Petrochemical
Noryl	Modified polyphenylene oxide	General Electric Co.
Nylafil	Nylon, glass-reinforced	Dart Industries, Inc.
Nylaflow	Nylon 6, 66, 610, fiberglass-reinforced	The Polymer Corp.
Nylaglas	Fiberglass-reinforced polyamide	Dart Industries, Inc.
Nylasar	Fiberglass-reinforced nylon	Dart Industries, Inc.
Nylatron	Nylon 6/6 (filled nylons)	The Polymer Corp.
Nypalube	TFE filled nylon injection molding compounds	Nypel Inc.
Nypelube	TFE filled nylons	Nypel Inc.
Nyreg	Glass-reinforced nylon 6 compounds	Nypel Inc.
Olane	Polypropylene	Amoco Chemicals Corp.
Olefil	Polypropylene	Amoco Chemicals Corp.
Oleflo	Polypropylene	Amoco Chemicals Corp.
Oleflow	Polypropylene pipe grade	Amoco Chemicals Corp.
Oleform	Modified polypropylene	Amoco Chemicals Corp.
Olemer	Propylene copolymer	Amoco Chemicals Corp.
Oletac	Amorphous polypropylene	Amoco Chemicals Corp.
Oletemp	Polypropylene	Amoco Chemicals Corp.
Olex	Polypropylene	Amoco Chemicals Corp.
Oroglas	Acrylic molding compounds	Rohm and Haas Co.
Parabis	Resin intermediate	Dow Chemical Co.
Paracryl	Butadiene-acrylonitrile copolymer	Uniroyal, Inc.
Paxon	High density polyethylene	Allied Corp.
Pedigree Products	Polyesters, epoxies	P.D. George, Inc.
Pelaspan	Expandable polystyrene	Dow Chemical Co.
Pelaspan-pac	Expandable polystyrene	Dow Chemical Co.
Penco	Thermoset resins & molding compounds	Plastics Engineering
Pentaphane	Chlorinated polyether	Hercules Incorporated
Petpac	PET resins	Celanese Plastics & Specialties Co.
Petrex	Alkyd	Hercules Incorporated
Petrothene	Polyethylene resin	U.S. Industrial Chemicals

Phenall	Phenolic molding compound	Allied Corp.
Phenolis	Phenol-formaldehyde	General Electric Co.
Phenuren	Phenol-formaldehyde resins	BASF Wyandotte Corp.
Picco	Hydrocarbon resins	Hercules Incorporated
Piccoflex	Styrene copolymer resins	Hercules Incorporated
Piccolastic	Styrene polymer resin	Hercules Incorporated
Piccopale	Petroleum resin	Hercules Incorporated
Piccosize	Petroleum resin emulsion	Hercules Incorporated
Piccoumaron	Hydrocarbon resins	Hercules Incorporated
Piccovar	Alkyl-aromatic resins	Hercules Incorporated
Plaskon	Synthetic molding compounds	Plaskon, Inc.
Plaslode	Talc & asbestos-reinforced polypropylene	Dart Industries, Inc.
Plaslube	Unreinforced polycarbonate, acetal & nylon	Dart Industries, Inc.
Plati Glas	Polypropylene	Phillips Chemical Co.
Platamid	Nylon 12	Rilsan Corp.
Plataril	Copolymers	Rilsan Corp.
Plenco	Thermoset resins & molding compounds	Plastics Engineering
Pleogen	Polyester resin	Whittaker Corp.
Plexiglas	Acrylic molding compounds	Rohm and Haas Co.
Pliolite (series)	Styrene butadiene copolymers	Goodyear Tire & Rubber Co.
Plio-Tuf	Styrene copolymer high impact resins	Goodyear Tire & Rubber Co.
Pliovic	PVC and copolymers	Goodyear Tire & Rubber Co.
Polycarbafil	Reinforced polycarbonate	Dart Industries, Inc.
Polycure	Crosslinked polyethylene compounds	Reichhold Chemicals, Inc.
Poly-Em	Polymeric emulsions, polyethylene	Gulf Oil Chemicals Co.
Poly-Em-Poly	Emulsified polyethylene	Gulf Oil Chemicals Co.
Poly-Eth	Polyethylene resin	Gulf Oil Chemicals Co.
Poly-Eth Hi-D	Polyethylene resin	Gulf Oil Chemicals Co.
Polyfibre	Polystyrene	Dow Chemical Co.
Polyfyde	Synthetic resins	Tenneco Chemicals, Inc.
Polyimide 2080	Thermoplastic polyimide	Upjohn Co.
Polylite	Polyester resins	Reichhold Chemicals, Inc.
Polyox	Water soluble resins	Union Carbide Corp.
Polyox	Epoxy resins	Reichhold Chemicals, Inc.
Poly-phen	Phenolic cast resin	Stepan Chemical Co.
Poly-pro	Polypropylene	Gulf Oil Chemicals Co.
Poly-ria	Urea-formaldehyde molding compounds	Stepan Chemical Co.
Polyset	Epoxy molding compounds	Morton Chemical Co.
Polystyrol	Styrene copolymer	BASF Wyandotte Corp.
Poly-Tex	Acrylic copolymer, acrylic/PVC copolymer	Celanese Plastics & Specialties Co.
Poly-The	Low and medium density polyethylene	Gulf Oil Chemicals Co.
Polytone	Polystyrene	Carl Gordon Industries
Polytool	Polyester, epoxy and phenolic tooling compounds	Reichhold Chemicals Inc.
Polytrend	Vinyl homopolymer dispersions	Tenneco Chemicals, Inc.
Pow'r-pak	Polypropylene, polystyrene & high density polyethylene	Northern Petrochemical
Procon	Polypropylene/fiberglass	Dart Industries, Inc.
Pro-Fax	Polypropylene resins	Hercules Incorporated
Profil	Reinforced polypropylene	Dart Industries, Inc.
Profoam	Expanded resin	Dow Chemical Co.
Proglas	Fiberglass-reinforced polypropylene	Dart Industries, Inc.
Propylsar	Fiberglass-reinforced polypropylene	Dart Industries, Inc.
Prospan	Expandable resin	Dow Chemical Co.
Pyroloy	Phenolic resins	Raybestos-Manhattan, Inc.
Resamin	Urea and melamine resins	American Hoechst Corp.
Resimene	Urea and melamine resins	Monsanto Co.
Resinox	Phenolic resins and compounds	Monsanto Co.
Resloom	Melamine resins	Monsanto Co.
Resorsabond	Resorcinol & phenol resorcinol	Pacific Resins & Chemicals
RJ 100/RJ 101	Styrene allyl alcohol resins	Monsanto Co.
Rohacell	Expanded polymethyl methacrylate	Rohm and Haas Co.
Rookplaz	Thermoplastic resin	GAF Corp.
Ruco	Polyesters for polyurethanes	Hooker Chemical & Plastics
Rucon	PVC resins	Hooker Chemical & Plastics
Rulan	Flame retardant plastic	DuPont Co.
Rynite	Glass-reinforced thermoplastic polyester	DuPont Co.
Ryton	Polyphenylene sulfide resins	Phillips Chemical Co.
Saduren	Melamine-formaldehyde resins	BASF Wyandotte Corp.
Santo-Rez	Wet-strength resins	Monsanto Co.
Santosize	Paste rosin sizes	Monsanto Co.
Saran	Vinylidene chloride resins	Dow Chemical Co.
Scrip set	Styrene maleic anhydride copolymer resins	Monsanto Co.
Selectron	Polyester resins	PPG Industries
Serrycel	Expanded resin	Dow Chemical Co.
Silmar	Polyester resin	Vistron Corp.
Skybond	Polyimide resins	Monsanto Co.
Styplast	Urea-formaldehyde molding compounds	FMC Corp.
Stypol	Polyester resins	Freeman Chemical Corp.
Styracon	Glass-reinforced polystyrene	Dart Industries, Inc.
Styrafil	Glass-reinforced polystyrene	Dart Industries, Inc.
Styraglas	Fiberglass-reinforced polystyrene	Dart Industries, Inc.
Styrasar	Fiberglass-reinforced polystyrene	Dart Industries, Inc.
Styresol	Styrenated alkyd resins	Reichhold Chemicals, Inc.
Styretex	Styrenated alkyd resins	Celanese Plastics & Specialties Co.

Styrocel	Styrene-methylmethacrylate	Dow Chemical Co.
Styrofoam	Extruded expanded polystyrene	Dow Chemical Co.
Styrolite	Expanded resin	Dow Chemical Co.
Styron	Polystyrene resin	Dow Chemical Co.
Styronal	Acrylate-styrene copolymer	BASF Wyandotte Corp.
Styropor	Expandable polystyrene beads	BASF Wyandotte Corp.
Styrospan	Expandable resin	Dow Chemical Co.
Styrotherm	Expanded resin	Dow Chemical Co.
Sulfasar	Fiberglass-reinforced polysulfone	Dart Industries, Inc.
Suifil	Fiberglass-reinforced polysulfone	Dart Industries, Inc.
Super-Beckacite	Phenolic resins	Reichhold Chemicals, Inc.
Super-Beckamine	Melamine-formaldehyde resins	Reichhold Chemicals, Inc.
Superdense	Impact polystyrene	Carl Gordon Industries, Inc.
Super Dylan	High density polyethylene resin	ARCO/Polymers, Inc.
Superflex	Grafted high impact polystyrene	Carl Gordon Industries, Inc.
Superflow	General purpose polystyrenes	Carl Gordon Industries, Inc.
Suprel	Polyethylene	Allied Corp.
Surlyn	Ionomer resin	DuPont Co.
Synolite	Polyester resins	Synres Chemical Corp.
Synresate	Alkyd resins	Synres Chemical Corp.
Synresyl	Polyvinyl acetate emulsions	Synres Chemical Corp.
Syntex	Alkyd resins	Celanese Plastics & Specialties Co.
Synthe-mul	Alkyd emulsions	Reichhold Chemicals, Inc.
Syn-U-Tex	Melamine & urea-formaldehyde resins	Celanese Plastics & Specialties Co.
Syretex	Styrenated alkyd resins	Celanese Plastics & Specialties Co.
Teflon (series)	Fluoropolymer resins	DuPont Co.
Tefzel	ETFE fluoropolymer	DuPont Co.
Tego	Phenolic	Rohm and Haas Co.
Tenite (series)	Molding & extrusion compounds	Eastman Chemical Products
Tere-Cast	Polyester casting compound	Reichhold Chemicals, Inc.
Tetra	Line of resins	Georgia Pacific Corp.
Tetra-phen	Phenolic resins	Georgia Pacific Corp.
Texalon	Nylon 6, 6/6	Texapol Corp.
Texrez	Polyvinyl acetate solutions	Celanese Plastics & Specialties Co.
Thermid	Polyimide	Gulf Oil Chemicals Co.
Thor	Phenol-formaldehyde	Borden, Inc.
Torlon	Polyamide-imide molding resin	Amoco Chemicals Corp.
Trak-less	Alkyd molding compound	American Cyanamid Co.
Trans-4	Polybutadiene	Phillips Chemical Co.
Tuf-Flex	Polystyrene	American Hoechst Corp.
Tybrene	ABS resins	Dow Chemical Co.
Tynex	Nylon 612 filaments	DuPont Co.
Tyril	SAN copolymer	Dow Chemical Co.
Tyrilfoam	SAN copolymer	Dow Chemical Co.
Tyrin	Chlorinated polyethylene	Dow Chemical Co.
Udel	Polysulfone	Union Carbide Corp.
Uformite	Urea and melamine resins	Rohm and Haas Co.
Ultradur	Polytetramethylene terephthalate	BASF Wyandotte Corp.
Ultraform	Acetal resins	BASF Wyandotte Corp.
Ultramid	Nylon 6, 6/6, 6/10	BASF Wyandotte Corp.
Ultrathene	Ethylene-vinyl acetate copolymer resins	U.S. Industrial Chemicals
Unisize	Polyvinyl alcohol	Air Products & Chemicals
Usslaminac	Polyester resins	USS Chemicals Div.
Valbond	Acrylic copolymer; unsaturated polyester	United Merchants, Inc.
Valco	DAP resins	United Merchants, Inc.
Valglas	Unsaturated polyester resins	United Merchants, Inc.
Valite	Phenolic resins	Valentine Sugars, Inc.
Valox	Polybutylene terephthalate	General Electric Co.
Vam	Vinyl acetate monomer	U.S. Industrial Chemicals
Varcum	Phenolic resins	Reichhold Chemicals, Inc.
Verelite	Polystyrene resins	Dow Chemical Co.
Versalon	Polyamide resins	Henkel Corp.
Versel	Polybutylene terephthalate	Allied Corp.
Vespel	Polyimide molding resins	DuPont Co.
Vestolit	PVC copolymer	Mobay Chemical Corp.
Vibramix	Polyester molding compounds	Uniroyal, Inc.
Vibrin	Polyester resins	USS Chemicals Div.
Vinac	Polyvinyl acetate emulsion	Air Products & Chemicals
Vinar	Polyvinyl acetate copolymer	Air Products & Chemicals
Vinlok	Acrylic emulsions	Celanese Plastics & Specialties Co.
Vinol	Polyvinyl alcohol	Air Products & Chemicals
Vinret	Polyvinyl acetate & acrylic latices	Celanese Plastics & Specialties Co.
Vinsol	High molecular weight phenolic	Hercules Incorporated
Vinuron	Styrene-modified PVC	BASF Wyandotte Corp.
Vituf	Polyester resin	Goodyear Tire & Rubber Co.
Vorafil	Synthetic resins & polymers	Dow Chemical Co.
Voraspan	Expandable plastic	Dow Chemical Co.
Vulkadur	Phenol-formaldehyde resin	Mobay Chemical Co.
Vxgen	PVC resins	General Tire & Rubber Co.
Vydyne	Nylon and nylon copolymer resins	Monsanto Co.
Vydyne R	Nylon mineral-reinforced resins	Monsanto Co.
Vygen	PVC resins & copolymers	General Tire & Rubber Co.
Vylor	Nylon monofilaments	DuPont Co.

Vynathene	Vinyl acetate-ethylene copolymer	U.S. Industrial Chemicals
Wallpol	Polyvinyl acetate emulsions	Reichhold Chemicals, Inc.
Waterez	Alkali-soluble, hard alkyd resins	Reichhold Chemicals, Inc.
Wave	Polyvinyl acetate copolymer	Air Products & Chemicals
Well-A-Meld	Reinforced nylon resins	Wellman, Inc.
Wellamid	Nylon 6, 6/6	Wellman, Inc.
Well-Blend	Blended nylon 6 and 6/6 resins	Wellman, Inc.
Well-Fibe	Fiberglass-reinforced nylon resins	Wellman, Inc.
Well-Kor	Mineral-reinforced nylon resins	Wellman, Inc.
Well-Sphere	Glass sphere-reinforced nylon resins	Wellman, Inc.
Wicacril	Acrylic emulsions	Celanese Plastics & Specialties Co.
Wingtack	Hydrocarbon resin	Goodyear Tire & Rubber
Wiitron	Polybutylene resins	Witco Chemical Co.
Wonder-Bond	Polyvinyl acetate	Borden, Inc.
X-tal	Nylon molding resin	Custom Resins, Inc.
XT Polymer	Acrylic multipolymer	American Cyanamid Co.
Xylok (series)	Thermosetting resins	Ciba-Geigy Corp.
Xylon	Nylon 6/6	Dart Industries, Inc.
Zerlon	Methyl methacrylate-styrene copolymers	Dow Chemical Co.
Zetafax	Ethylene-acrylic and ethylene-vinyl acetate	Dow Chemical Co.
Zetafin	Ethylene ethylacrylate copolymers	Dow Chemical Co.
Zytel	Nylon resins	DuPont Co.
1900	Ultra high molecular weight HDPE	Hercules Incorporated

ABS

Abtec Chemical	Abson
ARCO/Polymers	Dylel
BASF Wyandotte	Luran
Borg Warner Chemicals	Blendex, Cycolac, Cycoloy, Cycopac, Cycovin, Decoloy, Marbon
Dow Chemical	Tybrene
Monsanto	Lustran
USS Chemicals	Arylon T, Kralastic

SAN

Dart Industries	Acrylafil
Dow Chemical	Tyril
Monsanto	Lustran

EPOXY

Allied Chemical	Epiall
American Hoechst	Beckipex EP
ARCO/Polymers	Kopox, Kopoxite
BASF Wyandotte	Epoxin
Celanese Plastics & Specialties	Epiclor, Epi-cure, Epi-Rez, Epi-Tex
Ciba-Geigy	Araldite, Hydantoin
Dow Chemical	D.E.H., D.E.N., Der
3M Co.	Cardolite
Morton Chemical	Concord, Polyset
Reliance Universal	Capon
Reichhold Chemicals	Epotuf, Polyox, Polytool
Shell Chemical	Epocryl, Epon, Eponol

MELAMINE

American Cyanamid	Cymel, Melmac
American Hoechst	Resamin
Ashland Chemical	Aminp, Catadec
BASF Wyandotte	Kauramin, Luvipol, Saduren
Borden	Cascomel
Bostik South	Meltron
Celanese Plastics & Specialties	Syn-U-Tex
FMC	Avisco
Monsanto	Resimene, Resloom
Pacific Resins & Chemicals	Amres
Reichhold Chemicals	Super-Beckamine
Rohm and Haas	Uformite

NYLON

Allied Chemical	Capron
American Hoechst	Fosta
BASF Wyandotte	Ultramid
Belding	Moleculoy
Chemplast	Ertalon
Custom Resins	X-tal
Dart Industries	Xylon
DuPont	Dymetrol, Elvamide, Felor, Herox, Tynex, Vylor, Zytel
Henkel	Milvex, Versalon
Monsanto	Vydyne, Vydyne R
Rilsan	Platamid
Texapol	Texalon
Wellman	Wellamid, Well-Blend

PHENOLIC

Allied Chemical	Phenall
Ashland Chemical	Castastock, Catacol, Catacore, Catacote, Catafilm, Cataform, Catalac
BASF Wyandotte	Kauresin, Phenuren
Borden Chemical	Cascophen, Durite, Kastor Acrylon, Thor
Furane Plastics	Adlock
General Electric	Genal, Phenolls
Georgia-Pacific	Tetra-Phen
B.F. Goodrich Chemical	Hycar
Hooker Chemicals & Plastics	Durez
Mobay Chemical	Vulkadur
Monsanto	Resinox
Pacific Resins & Chemicals	Amres
Raybestos-Manhattan	Pyroloy
Reichhold Chemicals	Beckopol, Foundrez, Super Beckacite, Varcum
Rohm and Haas	Amberol, Tego
Sherwin Williams	Dyphene, Dyphenite
Stepan Chemical	Poly-phen
Union Carbide	Bakelite
Valentine Sugars	Valite

UNSATURATED POLYESTER & ALKYDS

American Cyanamid	Cypor, Trak-less
American Hoechst	Alftalat, Alpolit
ARCO/Polymers	Koplac
Ashland Chemical	Aropol
AZ Products	AZ Rez
Celanese Plastics & Specialties	Syretex
Freeman Chemical	Stypol
General Tire & Rubber	Genpol, Glykon
P.D. George	Pedigree Products
Glidden	Glidpol
ICI Americas	Atlac
Interplastic	CoRezyn
Koppers	Dion
Mobay Chemical	Alkydal, Multron
PPG Industries	Selectron
Reichhold Chemicals	Astroloy, Polylite, Polytool, Tera-Cast
Schenectady Chemicals	Isolite
Sherwin Williams	Dypol
Spencer Kellogg	Aroflat, Aroflint, Aroplaz
Synres Chemical	Synolite
Uniroyal Chemical	Vibramix
United Merchants	Valbond, Valglas
USS Chemicals	MR/Marco, Usslaminac, Vibrin
Vistron	Silmar
Westinghouse Electric	Fostercast
Whittaker	Pleogen

POLYETHYLENE

Allied Chemical	Paxon
American Hoechst	Hostalen
ARCO/Polymers	Super Dylan
BASF Wyandotte	Lupolen
Dart Industries	El Rey
Dow Chemical	Ethron, Tyrin
DuPont	Alathon
Gulf Oil Chemicals	Hex One, Poly-Eth, Poly-The
Hercules	Hi-fax, 1900
Northern Petrochemical	Norchem, Pow'r-pak
Phillips Chemical	Marlex
Soltex Polymer	Eltex, Fortiflex
Union Carbide	Bakelite
U.S. Industrial Chemicals	Microthene, Petrothene

POLYPROPYLENE

American Hoechst	Alprodur, Hostalen
Amoco Chemical	Avi-sun, Olane, Olefill, Oleflo, Oleflow, Oleform, Olemer, Oletemp, Olex
ARCO/Polymers	Dypro
BASF Wyandotte	Luparen
Dart Industries	El Rex, Le Rexene, Procon, Profil
Gulf Oil Chemicals	Poly-pro
Hercules	A-fax, Hercocel, Pro-fax
Northern Petrochemical	Pow'r-pak
Novamont	Moplen
Phillips Chemical	Plasti-Glas
Soltex Polymer	Fortilene

POLYSTRENE

A & E Plastik Pak	Bipak
American Hoechst	Fostafoam, Fostalite, Fostarene, Fosta Tuf-Flex
Amoco Chemicals	Forar
ARCO/Polymers	Dylene, Evenglo

BASF Wyandotte	Styropor
Dow Chemical	Pelaspan, Pelaspen-pac, Polyfibre, Styron, Styrospan, Styrotherm
Carl Gordon Industries	Polytone, Superdense, Superflex, Superflow
Monsanto	Cerex, Lustrex, Verelite
Northern Petrochemical	Pow'r-pak
Polysar Resin	E-Z Flow, Jet Flow

PVC

Abtec Chemical	Abson
American Hoechst	Hostaphan
BASF Wyandotte	Luvitherm, Vinuron
Diamond Shamrock	Dacovin, Intamix
Firestone Plastics	Exon
General Tire & Rubber	Vxgen, Vygen
B.F. Goodrich Chemical	Geon, Hi-Temp Geon
Goodyear Tire & Rubber	Pliovic
Great American Chemical	Irvinil
Hooker Chemicals & Plastics	Rucon
ICI Americas	Genclor
Mobay Chemical	Vestolit
Pantasote	Kohinoor
Tenneco Chemicals	Polytrend
Union Carbide	Bakelite

UREA

American Hoechst	Resamin
Ashland Chemical	Catabox
BASF Wyandotte	Fporka, Kaurit
Borden Chemical	Cascamite, Casco-Resin
Celanese Plastics & Specialites	Syn-U-Tex
Ciba-Geigy	Aerolite
FMC	Styplast
Monsanto	Resimene
Pacific Resins & Chemicals	Amres
Reichhold Chemicals	Fabroz, Foundrez
Rohm and Haas	Uformite
Stepan Chemical	Poly-ria

OTHER SOURCES OF PLASTICS INFORMATION

Business Consulting Groups and Publishers

Business Communications Co., Inc.—9 Viaduct Rd., Box 2070C, Stamford, Conn. 06906—203/325-2208

Chem Systems Inc.—747 Third Ave., New York, N.Y. 10016—212/421-9460

The Conference Board—845 Third Ave., New York, N.Y. 10022—212/759-0900

Frost & Sullivan, Inc.—106 Fulton St., New York, N.Y. 10038—212/233-1080

Hull & Co.—77 Pondfield Road, Bronxville, N.Y. 10708—914/779-8300

Charles H. Kline & Co.—330 Passaic Ave., Fairfield, N.J. 07006—201/227-6262

Arthur D. Little, Inc.—35 Acorn Park, Cambridge, Mass. 02140—617/864-5770

Margolis Marketing & Research Co.—232 Madison Ave., Suite 905, New York, N.Y. 10016—212/686-7198

Morton Research Corporation—1745 Merrick Avenue, Merrick, N.Y. 11566—516/378-1066

Noyes Data Corp.—Mill Road at Grand Ave., Park Ridge, N.J. 07656—201/391-8484

Predicasts, Inc.—200 University Circle Research Center, 11001 Cedar Ave., Cleveland, Ohio 44106—216/795-3000

Peter Sherwood Associates, Inc.—60 East 42nd St., New York, N.Y. 10017—212/687-3653

Skeist Laboratories, Inc.—112 Naylon Ave., Livingston, N.J. 07039—201/994-1050

Springborn Laboratories—P.O. Box J, Hazardville Station, Enfield, Conn. 06082—203/749-8371

SRI International—Menlo Park, Cal. 94025—415/326-6200

Technomic Publishing Co.—265 W. State St., Westport, Conn. 06880—203/226-6356

Technomic Research Associates, Inc.—1 North Wacker Drive, Chicago, Ill. 60606—312/346-5901

Roger Williams Technical & Economic Services, Inc.—34 Washington Road, P.O. Box 426, Princeton, N.J. 08540—609/799-1200

Government Publications

Annual Survey of Manufactures—Bureau of Census

Census of Manufactures—Bureau of the Census

Current Industrial Reports—Bureau of the Census

Foreign Trade Reports: FT 135 (imports), FT 410 (exports)—Bureau of the Census

Guide to Census Bureau Data Files and Special Tabulations—Bureau of the Census

Guide to Foreign Trade Statistics—Bureau of the Census

Mineral Industry Surveys—Bureau of Mines

Producer Price Indexes—Bureau of Labor Statistics

Standard Industrial Classification Manual—Office of Federal Statistical Policy and Standards

Statistical Abstract of the U.S.—Department of Commerce

Statistical Services of the U.S. Government—Office of Management and Budget

Synthetic Organic Chemicals—International Trade Commission

U.S. Industrial Outlook—Department of Commerce

Newspapers

Chemical Marketing Reporter—100 Church St., New York, N.Y. 10007—212/732-9820

Journal of Commerce—110 Wall St., New York, N.Y. 10005—212/425-1616

Rubber & Plastics News—1 Cascade Plaza, Suite 1302, Akron, Ohio 44308—216/253-2183

Trade Associations & Professional Organizations

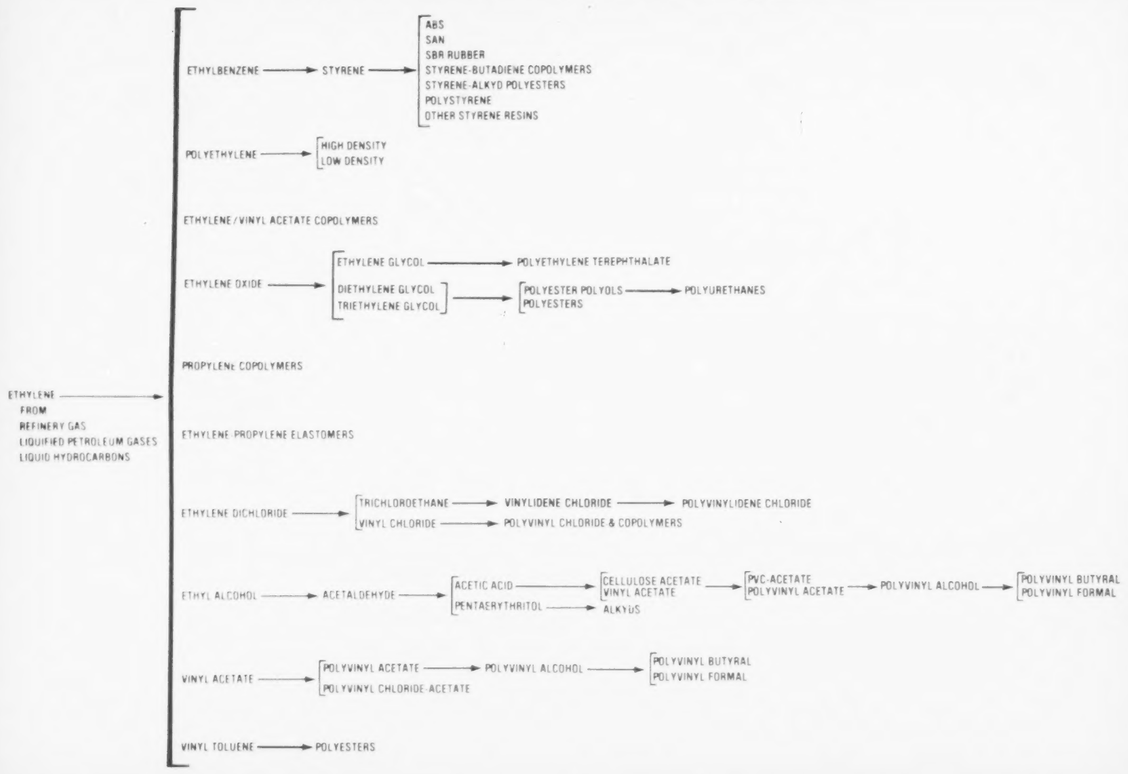
American Chemical Society—1155 16th St. N.W., Washington , D.C. 20036—202/872-4600
Chemical Coaters Assn.—Box 241, Wheaton, Ill. 60187—312/668-0949
Chemical Fabrics & Film Assn.—1230 Keith Bldg., Cleveland, OH 44115—216/241-7333
Chemical Manufacturers Assn.—2501 M St. NW, Washington, D.C. 20037—202/887-1100
Chemical Marketing Research Assn.—139 Chestnut Ave., Staten Island, N.Y. 10305—212/727-0550
Chemical Specialties Manufacturers Assn.—1001 Connecticut Ave., NW, Washington, D.C. 20036 —202/872-8110
Composite Can & Tube Institute—1800 M St. NW, Washington, D.C. 20036—202/223-4840
Drug, Chemical & Allied Trades Assn.—42-40 Bell Blvd., Suite 204, Bayside, N.Y. 11361—212/229-8891
Dry Color Manufacturers Assn.—Suite 100, 1117 North 19th St., Arlington, VA 22209—703/525-9483
Flexible Packaging Assn.—1111 19th St., N.W., Washington, D.C. 20036
INDA—1700 Broadway, New York, N.Y. 10019—212/582-8401
International Institute of Synthetic Rubber Producers—2077 S. Gessner Rd., Suite 133, Houston, TX 77077—713/783-7511
National Paint & Coatings Assn.—1500 Rhode Island Ave. NW, Washington, D.C. 20005 —202/462-6272
Polyurethane Manufacturers Assn.—Box 35368, Phoenix, AZ 85069—602/973-7772
Rubber Manufacturers Assn.—1901 Pennsylvania Ave. NW, Washington, D.C. 20006—202/785-2602
Society of Plastic Engineers—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Society of the Plastics Industry-Canada—1262 Don Mills Road, Don Mills, Ontario M3B2W7 —416/449-3444
Synthetic Organic Chemical Manufacturers Assn.—1075 Central Park Ave., Scarsdale, N.Y. 10583 —914/725-1492

Trade Publications

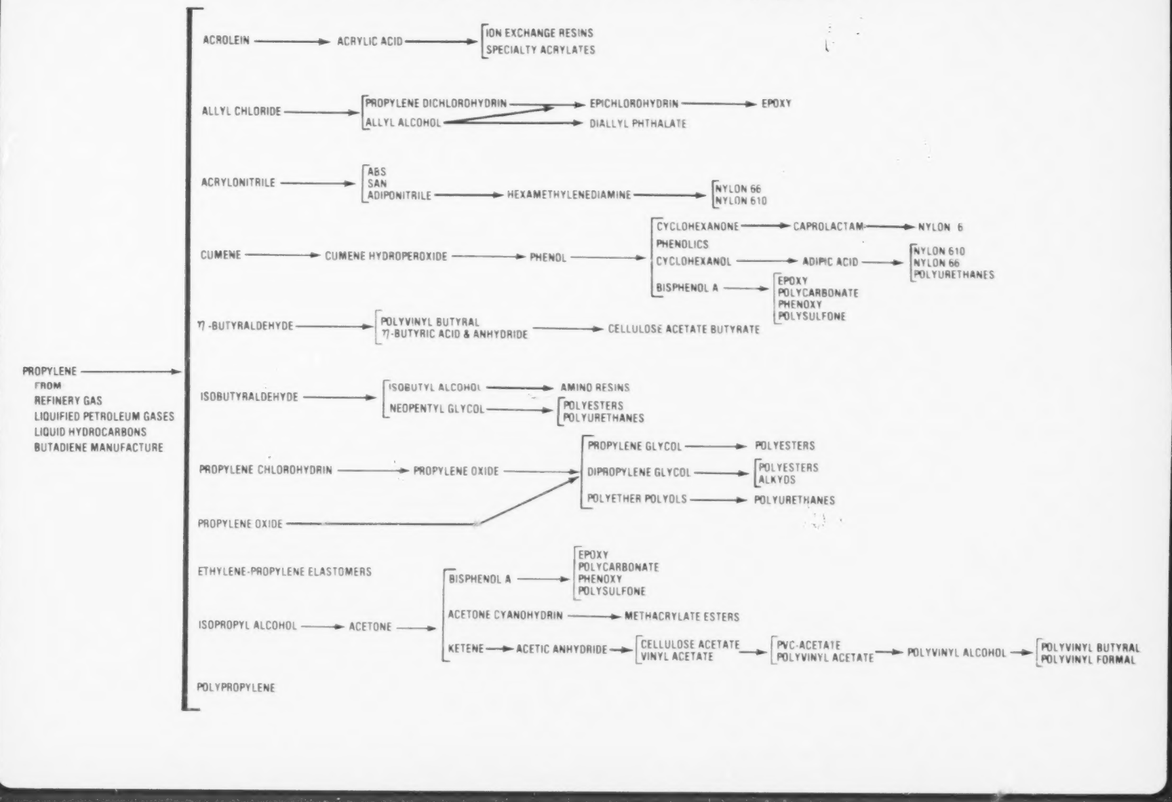
Canadian Plastics—1450 Don Mills Road, Don Mills, Ontario M3B2X7—416/445-6641
Chemical Engineering—1221 Ave. of the Americas, New York, N.Y. 10020—212/997-2464
Chemical & Engineering News—733 Third Ave., New York, N.Y. 10017—212/679-6210
Chemical Week—1221 Ave of the Americas, New York, N.Y. 10020—212/997-2922
Market Search, Inc.—P.O. Box 2886, Toledo, OH 43606
Materials Engineering—Penton Plaza, Cleveland, Ohio 44114—216/696-7000
Modern Packaging—205 East 42nd St., New York, N.Y. 10017—212/573-8107
Modern Plastics—1221 Ave. of the Americas, New York, N.Y. 10020—212/997-1221
Packaging Digest—201 East 42nd St., New York, N.Y. 10017—212/867-9191
Plastics Compounding—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Platics Design Forum—1129 East 17th Ave., Denver CO 80218—303/832-1022
Plastics Design & Processing—700 Peterson Rd., Libertyville, IL 60048—312/362-8711
Plastics Engineering—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Plastics Focus—95 Madison Ave., Room 806, New York, N.Y. 10016—212/679-7902
Plastics Industry News—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Machinery & Equipment—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Technology—633 Third Ave., New York, N.Y. 10017—212/986-4800
Plastics World—221 Columbus Ave., Boston, MA 02116—617/536-7780

Facts & Figures of the Plastics Industry

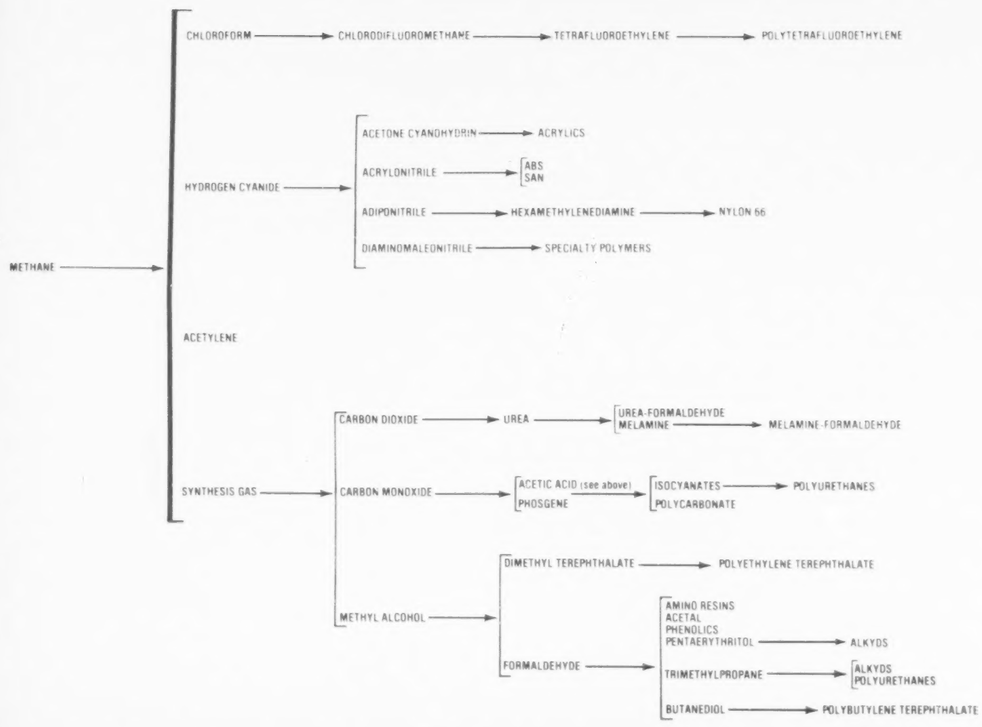
Plastics Derived from Ethylene



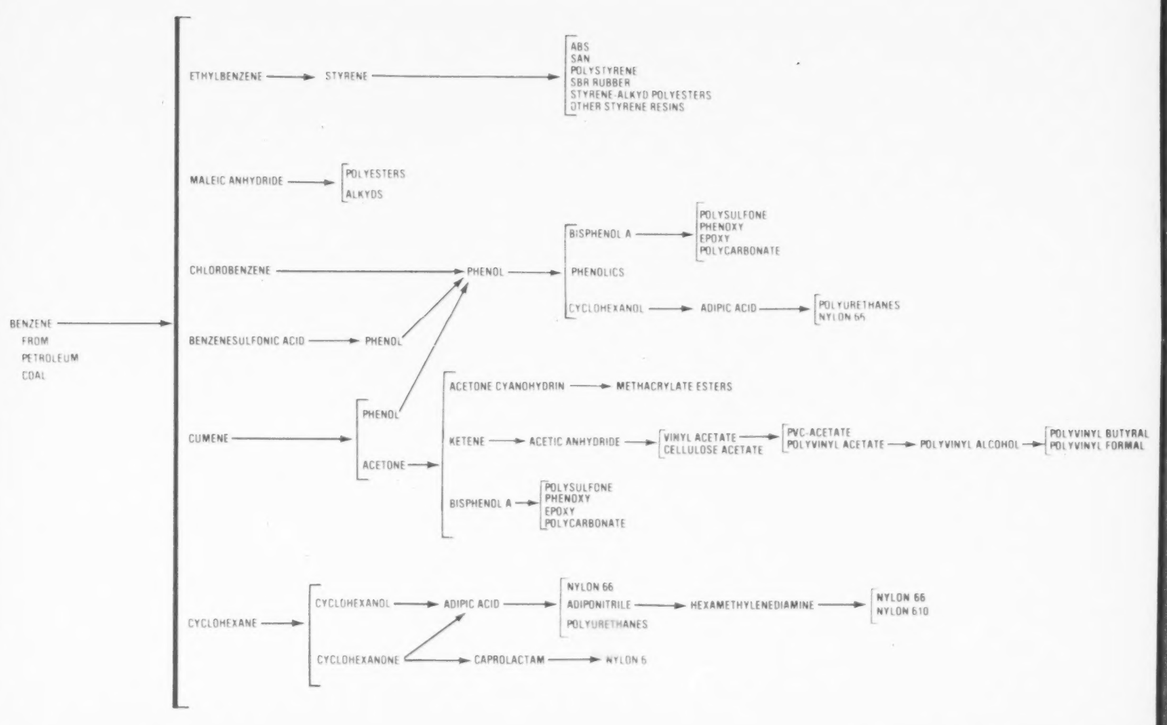
Plastics Derived from Propylene



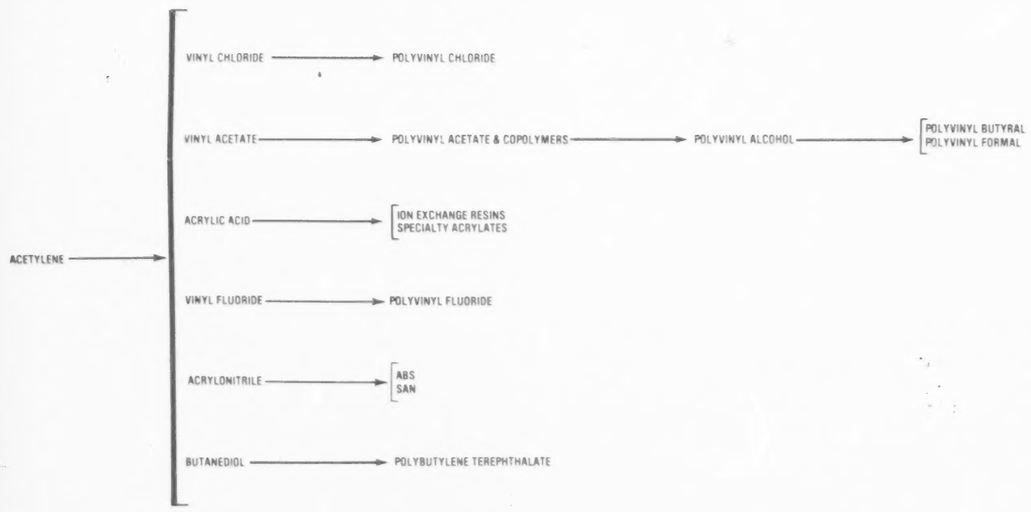
Plastics Derived from Methane



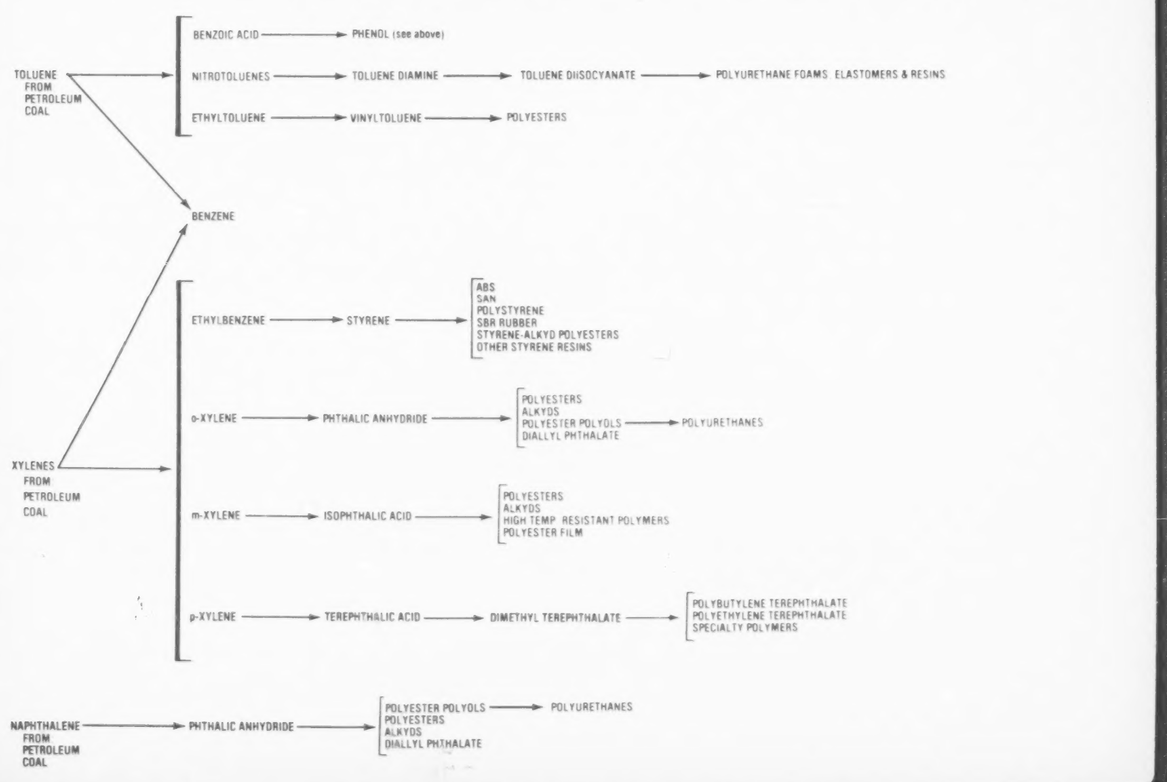
Plastics Derived from Benzene



Plastics Derived from Acetylene



Plastics Derived from Naphthalene, Toluene & Xylenes



COMMITTEE ON RESIN STATISTICS

SPI'S COMMITTEE ON RESIN STATISTICS

The Committee on Resin Statistics, only one of the more than sixty Operating Units within the Society of the Plastics Industry is composed of 130 representatives from plastics resin producing companies, trade publications, industry-related professional organizations, and various agencies of the Federal government. All members of the Committee are quite knowledgeable of the rapidy growing plastics industry and have a special interest in the development of marketing and economic data.

At present the Committee is responsible for the development and maintenance of a monthly report on the major plastics materials. This report shows monthly and cumulative data on Production and Sales & Use (including captive operations) with percent change from the previous year. It is the only detailed monthly report on plastics materials now available. There are one hundred twenty-five producers participating in the monthly program and they are believed to represent about 95% of total U.S. plastics production. Many of the materials covered reflect 100% industry coverage. The data are compiled by Ernst & Whinney, nationally renowned Independent Public Accountants.

The Committee is actively involved with the various departments of the Federal Government (International Trade Commission, Department of Commerce, Bureau of Census, Department of Energy, Bureau of Labor Statistics, etc.) assisting them in the development and improvement of the plastics segments of their special reports.

The Committee is also responsible for monitoring all resin data which appear in FACTS & FIGURES, thus assuring the most accurate and timely data available on the plastics industry.

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The Society of the
Plastics Industry, Inc.

SPI

1982 edition

Facts & Figures of the U.S. Plastics Industry

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First Printing: September 1982

FACTS & FIGURES is prepared annually by H. Kibbel of the Statistical Department under the supervision of A. J. Evans, Director. All inquiries regarding its content should be addressed to that department at The Society of the Plastics Industry, Inc., 355 Lexington Avenue, New York, N.Y. 10017.

Price: $45.00 (SPI members); $90.00 (non-members)

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.

The Society of the Plastics Industry, Inc. is a member-run federation dedicated to promoting and protecting continuing growth for the plastics industry in the United States. The Society represents more than 1,400 members responsible for over 95 percent of plastics materials production and 75 percent of U.S. plastics product sales.

SPI's 70 operating units and more than 300 committees have membership drawn from all segments of the industry—processors, resin and adjuvant suppliers, plastics distributors, machinery builders, and moldmakers. The Society serves as a federation of semi-autonomous, interrelated groups with a strong, common interest in the overall health of the plastics industry.

SPI serves as the "industry spokesman." It identifies and provides positive responses to misinformation and to potentially harmful regulations, bills, or court decisions by mobilizing pertinent facts and carrying out programs for timely and forceful action. At the same time, SPI works to prevent such damaging situations from occurring by building a positive understanding of the industry. The Society's service committees provide liaison with government agencies, code and regulatory groups, and many other associations.

SPI sponsors research projects in areas such as energy use, resource recovery, combustibility, and worker safety, at major private research organizations. The Society conducts numerous information programs, providing literature, surveys, reports, newsletters, and handbooks for industry and public use.

SPI sponsors one of the largest trade shows in the United States—the National Plastics Exposition, held every three years. The last show, held in June 1982, drew more than 40,000 visitors who viewed the products and services of more than 500 exhibitors.

Incorporated in 1937, SPI has grown with the dynamic industry it represents. In addition to the Society's headquarters office in New York City, SPI has five section offices: Eastern Section, 169 Union Boulevard, Totowa, NJ 07512; New England Section, 20 Speen Street, Framingham, MA 01701; Midwestern Section, 3150 Des Plaines Avenue, Des Plaines, IL 60018; Washington, D.C. Office, 1724 H Street, N.W., Washington, D.C. 20006, and Western Section, Saddleback Square, Suite 124, 12440 Firestone Boulevard, Norwalk, CA 90650.

SPI draws together the diverse segments of the plastics industry into an effective organization that represents the entire industry.

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DEVELOPMENT OF TODAY'S PLASTICS

Today's plastics are one of the most used material on a volume basis in America's industrial and commercial life. The role of plastics is so broadly integrated in our own lifestyle that today there is virtually no product area where plastics do not make a major, irreplaceable contribution. Although the plastics industry in the United States is now in its second century, the most important developments have occurred since 1910. However, the roots of these modern developments go back not only to the research of cellulose nitrate by John Wesley Hyatt in the 1860's, but also to the plastic-like compositions used by man through the centuries.

ORIGIN OF PLASTICS

One can go as far back as the Old Testament to find references about natural materials used as fillers, adhesives, coatings, and the like. These materials were the precursors of what we call plastic materials today. Consequently, historians differ as to the exact date that the plastics industry began, and they will continue to do so since an exact year or even decade for the event is a matter of interpretation as to what constitutes a "plastic."

Certainly the history of the rubber industry has a bearing on plastics since ebonite, or hard rubber, discovered in 1851, was the first thermosetting material to be prepared and also the first material which involved a distinct chemical modification of a natural material. But ebonite was not exploited commercially for some years after its discovery and for that reason its historical importance has become somewhat blurred.

EUROPEAN DEVELOPMENTS

While the basic processes of rubber technology were developing, other important discoveries were taking place in Europe. Following work by Pelouze, Schonbein was able to establish conditions of controlled nitration of cellulose. The product soon became of interest as an explosive and in the manufacture of collodion, a cellulose solution in an alcohol-ether mixture. In the 1850's the English inventor Alexander Parkes observed that the solid residue left after the evaporation of the solvent of photographic collodion was a "hard, horny elastic and waterproof substance." In 1856 he patented the process of waterproofing woven fabrics by the use of such materials.

In 1862 the Great International Exhibition was held in London. It was there that Parkes introduced a new material named for himself—Parkesine. Parkesine was obtained by dissolving cellulose nitrate in a minimum of solvent. The mixture was then put on a heated rolling machine from which some of the solvent was then removed. While still in the plastic state the material was then shaped by dies or pressure. In 1866 Parkes organized the Parkesine Company to manufacture products from his new material, but the company failed in 1868. This appears in part due to Parkes' attempt to reduce production costs which resulted in the production of inferior items.

One year after the failure of the Parkesine Company, an associate of Parkes, Daniel Spill, formed the Xylonite Company to manufacture products similar to Parkesine. Once again economic failure resulted and Spill's company went bankrupt in 1874. Undaunted, Spill moved to a new site, established the Daniel Spill Company and continued production of his material, Xylonite.

FIRST PLASTICS IN THE U.S.

In the United States during the 1860's someone else was experimenting with cellulose nitrate—John Wesley Hyatt. In 1865 Hyatt became involved in devising a method for producing billiard balls from materials other than ivory. Originally using mixtures of cloth, ivory dust and shellac, in 1869 he patented the use of collodion for coating billiard balls. The patent came one year after his collodion material was introduced commercially.

John W. Hyatt and his brother Isaiah took out U.S. Patent 105,338 in 1870 for a process of producing a horn-like material using cellulose nitrate and camphor. Although Parkes and Spill had mentioned camphor in their work it was the Hyatt brothers who recognized the value of camphor as a plasticizer for cellulose nitrate. In 1872 the term celluloid was coined by Isaiah Hyatt to describe the Hyatts' commercially successful product.

The validity of Hyatts' patents was challenged by Spill and a number of court actions took place between 1877 and 1884. In the final action it was found that Spill had no claim on the Hyatt brothers, the judge ruling that the true inventor of the process was Parkes since he (Parkes) had mentioned the use of camphor in his patents. Thus, there was no restriction on the use of these processes and any company, including the Hyatts' Celluloid Manufacturing Company, were free to use them. After that decision the Celluloid Manufacturing Company prospered, changed its name to the American Celluloid Chemical Corporation, and eventually was absorbed by the Celanese Corporation.

FORMALDEHYDE RESINS

Next to cellulose nitrate the most important material in the early history of plastics was formaldehyde. Around 1897 there was a demand in German schools for a white chalkboard. Efforts to obtain such a product resulted in the discovery of casein plastics, produced by reacting casein (milk protein) with formaldehyde. The material soon became established under the trade names of Galalith and Erinoid, and today casein is still used by the button industry.

In 1899 Arthur Smith took out British Patent 16,274, the first dealing with phenol-formaldehyde resins, in this case for use as an ebonite substitute in electrical insulation. During the next decade the phenol-formaldehyde reaction was investigated mainly for academic interest. In 1907 however, Leo Hendrik Baekeland discovered techniques of so controlling and modifying the reaction that useful products could be made from it. Thus phenolics were the first fully synthetic resins to become commercially successful.

Prompted by the success of phenolic moldings, research began on reacting other materials, such as urea and thiourea, with formaldehyde. These materials were used in the manufacture of molding powders. Unlike the phenolics, they could be molded into light-colored articles and they rapidly achieved commercial success. Today these urea-based resins are used for molding powders, adhesives, and textile and paper finishing while the related melamine-formaldehyde resins are used in decorative laminates.

GROWTH OF MODERN PLASTICS

Cellulose acetate, a thermoplastic, was developed about the same time as the urea-based resins. Similar in structure to cellulose nitrate, it was found to be safer in processing and use. Cellulose acetate was introduced as a molding compound in 1927.

The period 1930-1940 saw the initial commercial development of today's major thermoplastics; polyvinyl chloride; low density polyethylene; polystyrene; and polymethyl methacrylate. The advent of the Second World War in 1939 brought plastics into great demand, largely as substitutes for materials in short supply, such as natural rubber. In the United States the crash program leading to large-scale production of synthetic rubbers resulted in extensive research into the chemistry of polymer formation, and eventually, to the development of more plastic materials.

The first decade after World War II saw the development of high density polyethylene and polypropylene and the growth of the newer plastics in many applications. Large-scale production of these materials reduced their cost dramatically. The new materials began to compete with the older plastics and even with the more traditional materials such as wood, paper, metal, glass and leather. Since that time the demand for plastics has increased steadily so that plastics are now accepted by designers and engineers as basic materials along with the more traditional materials. The automotive industry, for instance, relies on plastics to reduce weight and thus increase mileage.

INTRODUCTION OF PLASTICS RESINS

DATE	MATERIAL	EXAMPLE
1868	Cellulose Nitrate	Eye Glass Frames
1909	Phenol-Formaldehyde	Telephone Handset
1919	Casein	Knitting Needles
1926	Alkyd	Electrical Bases
1927	Cellulose Acetate	Tooth Brushes
1927	Polyvinyl Chloride	Wall Covering
1929	Urea-Formaldehyde	Lighting Fixtures
1935	Ethyl Cellulose	Flashlight Cases
1936	Acrylic	Brush Backs
1936	Polyvinyl Acetate	Flash Bulb Lining
1938	Cellulose Acetate Butyrate	Packaging
1938	Polystyrene	Housewares
1939	Nylon	Gears
1939	Polyvinylidene Chloride	Packaging Film
1939	Melamine-Formaldehyde	Tableware
1942	Unsaturated Polyester	Boat Hulls
1942	Low Density Polyethylene	Packaging
1943	Fluoropolymers	Industrial Gaskets
1943	Silicone	Motor Insulation
1945	Cellulose Propionate	Pens and Pencils
1947	Epoxy	Tools and Jigs
1948	Acrylonitrile-Butadiene-Styrene (ABS)	Luggage
1954	Styrene-Acrylonitrile (SAN)	Housewares
1954	Polyurethane	Foam Cushions
1956	Acetal	Automotive Parts
1957	High Density Polyethylene	Milk Bottles
1957	Polypropylene	Safety Helmets
1957	Polycarbonate	Appliance Parts
1959	Chlorinated Polyether	Valves and Fittings
1962	Phenoxy	Bottles
1964	Ionomer	Skin Packaging
1964	Polyphenylene Oxide	Battery Cases
1964	Polyimide	Bearings
1964	Ethylene-Vinyl Acetate	Adhesives and Coatings
1965	Polysulfone	Electrical/Electronic Parts
1970	Thermoplastic Polyester	Electrical/Electronic Parts
1973	Polybutylene	Piping
1973	Polyphenylene Sulfide	Telecommunications
1974	Polyethersulfone	Printed circuit boards
1975	Nitrile Barrier Resins	Non-food Packaging
1978	Linear Low Density Polyethylene	Extruded Film

1981 IN REVIEW—PRODUCTION AND SALES & CAPTIVE USE*
(in millions of pounds)

Resin	Production			Sales & Captive Use		
	1981	1980	% Change	1981	1980	% Change
Epoxy	336	315	6.7	332	319	4.1
Phenolic**	2,333	1,499	n.c.	2,375	1,517	n.c.
Polyester	997	947	5.3	977	949	3.0
Urea	1,165	1,165	—	1,139	1,147	—0.7
Melamine	179	167	7.2	175	166	5.4
Total Selected Thermosets	5,010	4,093	n.c.	4,998	4,098	n.c.
ABS	916	920	—0.4	900	916	—1.7
SAN	107	111	—3.6	105	103	1.9
HDPE	4,695	4,405	6.6	4,683	4,394	6.6
LDPE	7,693	7,291	5.5	7,516	7,467	0.7
Nylon	312	274	13.9	288	271	6.3
Polypropylene	3,955	3,648	8.4	3,888	3,714	4.7
Polystyrene	3,621	3,521	2.8	3,604	3,518	2.4
PVC	5,707	5,470	4.3	5,601	5,407	3.6
Thermoplastic Polyester	610	503	21.3	581	511	13.7
Total Selected Thermoplastics	27,616	26,143	5.6	27,166	26,301	3.3
Total Selected Plastics	32,626	30,236	n.c.	32,164	30,399	n.c.
All Other Plastics	7,241	7,111	1.8	4,792	4,787	0.1
Grand Total	39,867	37,347	n.c.	36,956	35,185	n.c.

*Excludes Polyurethane. **Reported on gross weight basis in 1981. n.c. = not comparable.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

1981 IN REVIEW—
DISTRIBUTION OF SALES & CAPTIVE USE BY MAJOR MARKET
(in millions of pounds)

Major Market	1981	1980	% Change	Share of Total 1981	Share of Total 1980
Transportation	1,573	1,605	— 2.0	4.3%	4.6%
Packaging	10,465	10,003	+ 4.6	28.3	28.4
Building/Construction	7,259	6,424	+13.0	19.6	18.3
Electrical/Electronic	2,670	2,453	+ 8.8	7.2	7.0
Furniture/Furnishings	1,670	1,646	+ 1.5	4.5	4.7
Consumer/Institutional	3,670	3,553	+ 3.3	9.9	10.1
Industrial/Machinery	393	391	+ 0.5	1.1	1.0
Adhesives, Inks & Coatings	2,572	2,387	+ 7.8	7.0	6.8
Other	3,259	3,054	+ 6.7	8.8	8.7
Exports	3,425	3,670	— 6.7	9.3	10.4
Total	36,956	35,186	+ 5.0	100.0%	100.0%

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

TOTAL U.S. PRODUCTION AND SALES & CAPTIVE USE OF PLASTICS RESIN: 1956-1981
(in millions of pounds)

YEAR	PRODUCTION (Excluding Polyurethane)	POLYURETHANE PRODUCTION[d]	PRODUCTION (Including Polyurethane)	SALES & CAPTIVE USE (Excluding Polyurethane)
[a]1956	3,991	8	3,999	3,406
1957	4,385	17	4,402	3,740
1958	4,578	33	4,611	4,003
1959	5,925	67	5,992	5,097
1960	6,226	95	6,321	5,277
1961	6,780	150	6,930	5,905
1962	7,977	220	8,197	6,952
[b]1963	9,084	280	9,364	7,380
1964	10,230	295	10,525	8,581
1965	11,829	390	12,219	10,684
1966	13,719	480	14,199	11,294
1967	13,923	550	14,473	11,789
1968	16,581	650	17,231	14,811
1969	18,935	785	19,720	15,788
1970	19,226	830	20,056	16,747
[c]1971	20,201	960	21,161	18,949
1972	25,285	1,190	26,475	24,433
1973	27,783	1,430	29,213	27,432
1974	27,944	1,330	29,274	26,693
1975	21,588	1,240	22,828	21,162
1976	27,646	1,550	29,196	26,984
1977	32,098	1,850	33,948	31,106
1978	35,655	1,950	37,605	35,063
1979	39,477	2,100	41,577	38,717
1980	35,447	1,900	37,347	35,186
1981	37,817	2,050	39,867	36,956

[a]U.S. Tariff Commission data used for 1956-1970. May exclude some captive use.
[b]Cellulosics not included through 1962. Included beginning in 1963.
[c]SPI data used for 1971-1981
[d]***Chemical Economics Handbook,*** SRI International, Menlo Park, Cal.

Compound Growth Rate

Years	Total Production	Sales & Captive Use
1956-1981	9.6%	10.0%
1966-1981	7.1%	8.2%
1971-1981	6.5%	6.9%
1976-1981	6.4%	6.5%
1980-1981	6.7%	5.0%

1982

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN*

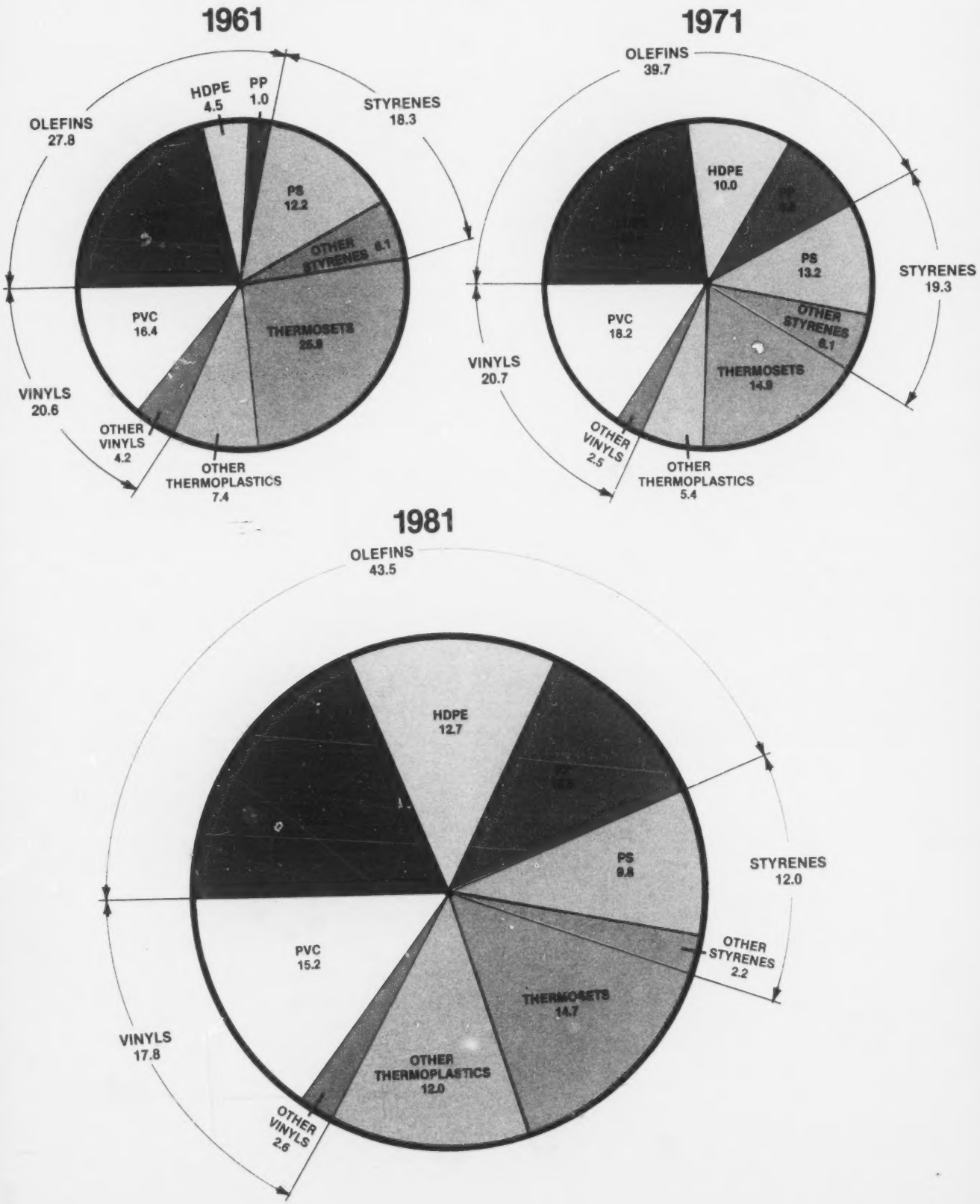
(in millions of pounds)

Resin	1977		1978		1979		1980		1981		Compound Growth Rate 1976-1981 Sales & Captive Use
	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	Production	Sales & Captive Use	
Epoxy	261	278	299	316	361	332	315	319	336	332	5.8%
Phenolic	1,458	1,400	1,617	1,543	1,781	1,732	1,489	1,517	2,333	2,375	**
Polyester	1,061	1,045	1,209	1,199	1,147	1,152	947	949	997	977	0.4
Urea	963	951	1,122	1,103	1,367	1,355	1,165	1,147	1,165	1,139	7.1
Melamine	200	203	202	196	200	192	167	166	179	175	— 0.8
Total Selected Thermosets	3,943	3,877	4,449	4,357	4,856	4,763	4,093	4,098	5,010	4,998	7.4
ABS	1,069	1,057	1,134	1,118	1,191	1,183	920	916	916	900	— 0.5
SAN	115	113	120	121	124	126	111	103	107	105	0.2
HDPE	3,652	3,557	4,201	4,165	5,010	4,893	4,405	4,394	4,695	4,683	8.4
LDPE	6,471	6,488	7,111	7,147	7,793	7,815	7,291	7,467	7,693	7,516	5.5
Nylon	254	250	275	278	327	315	274	271	312	288	5.4
Polypropylene	2,747	2,698	3,074	3,055	3,841	3,894	3,648	3,714	3,955	3,888	8.9
Polystyrene	3,446	3,557	3,823	3,870	4,005	3,997	3,521	3,518	3,621	3,604	2.8
PVC	5,253	5,232	5,723	5,810	6,119	6,138	5,470	5,407	5,707	5,601	3.9
Thermoplastic Polyester	—	—	—	—	—	—	503	511	610	581	—
Total Selected Thermoplastics	23,007	22,952	25,461	25,564	28,410	28,361	26,143	26,301	27,616	27,166	5.8
Total Selected Plastics	26,950	26,829	29,910	29,921	33,266	33,124	30,236	30,399	32,626	32,164	6.1
All Other Plastics	6,998	4,227	7,695	5,142	8,311	5,593	7,111	4,786	7,241	4,792	9.7
Grand Total	33,948	31,106	37,605	35,063	41,577	38,717	37,347	35,185	39,867	36,956	6.5%

*Sales & Captive Use excludes Polyurethane. **Not applicable since reporting on gross weight basis begun in 1981.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PERCENTAGE DISTRIBUTION OF PLASTIC SALES & CAPTIVE USE BY MATERIAL



PLASTICS RESINS DOMESTIC MERCHANT SALES
(in millions of dollars and millions of pounds)

Resin	1981		1980		% Change	
	Net Dollar Value	Quantity	Net Dollar Value	Quantity	Net Dollar Value	Quantity
Low Density Polyethylene	$ 2,077	5,748	$ 1,974	5,323	+ 5.2	+ 8.0
Polystyrene	1,446	3,104	1,358	2,925	+ 6.5	+ 6.1
High Density Polyethylene	1,414	3,786	1,237	3,469	+14.3	+ 9.1
Polyvinyl Chloride	1,244	4,413	1,337	4,230	− 7.0	+ 4.3
Polypropylene	1,015	2,636	793	2,483	+28.0	+ 6.2
ABS	635	845	527	858	+20.5	− 1.5
Polyester	549	913	510	881	+ 7.6	+ 3.6
Other Styrenes	488	656	554	669	−11.9	− 1.9
Phenolic*	449	1,979	495	1,107	− 9.3	n.c.
Nylon	367	249	298	229	+23.2	+ 8.7
Epoxy	338	291	267	284	+26.6	+ 2.5
Urea	231	1,130	193	1,077	+19.7	+ 4.9
Other Vinyls	125	100	111	102	+12.6	− 2.0
Melamine	108	131	89	123	+21.3	+ 6.5
Polyvinyl Alcohol	102	110	96	115	+ 6.3	− 4.3
SAN	58	87	50	85	+16.0	+ 2.4
All other (excluding polyvinyl acetate and polyurethane)	2,758	2,660	2,793	3,085	− 1.3	−13.8
Total	$13,404	28,838	$12,682	27,045	+ 5.7	+ 6.6

*Reported on gross weight basis beginning in 1981. n.c. = not comparable

Domestic merchant sales are quantities of sales excluding interplant transfers, captive consumption and exports.

Net dollar value represents the actual selling price after deductions for cash discounts, quantity discounts, returned goods and allowances, federal excise taxes, local taxes, and outgoing transportation (prepaid or otherwise) to warehouses or customers.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

APPARENT U.S. CONSUMPTION OF SELECTED PLASTICS RESINS

Apparent consumption is calculated by adding imports to production then subtracting exports. It is an accurate measure of the quantity of material actually consumed in the United States.

For purposes of the table below, the production figures were taken from SPI's Monthly Statistical Report, as compiled by Ernst & Whinney. Both the import and export figures were taken from Bureau of the Census reports.

1981
(in millions of pounds)

Resin	Production	Imports	Exports	Apparent Consumption
Low Density Polyethylene	7,693	36	971	6,758
Polyvinyl Chloride	5,707	75	466	5,316
Polystyrene & Styrene Copolymers	4,451	25	288	4,188
High Density Polyethylene	4,695	97	637	4,155
Polypropylene	3,955	7	654	3,308
Phenolic	2,333	17	46	2,304
Urea	1,165	4	10	1,159
Unsaturated Polyester	997	2	106	893
Acrylonitrile Butadiene Styrene	916	2	95	823
Thermoplastic Polyester[a]	610	4	94	520
Nylon	312	4	38	278
Epoxy	336	5	92	249
Other Vinyls	208	4	42	170
Melamine	179	1	16	164
Polyvinyl Alcohol	139	24	23	140
Total of these resins	33,696	307	3,578	30,425
1980 Total	31,247	247	4,194	27,300
1979 Total	34,550	273	3,625	31,198
1978 Total	31,101	234	2,302	29,033
1977 Total	28,077	136	1,978	26,235
1976 Total	25,565	135	2,185	23,515

[a]Not included in total 1976-1979.

Source: Production—SPI Monthly Statistical Report, as compiled by Ernst & Whinney
Imports—Bureau of the Census, IM 146
Exports—Bureau of the Census, EM 546

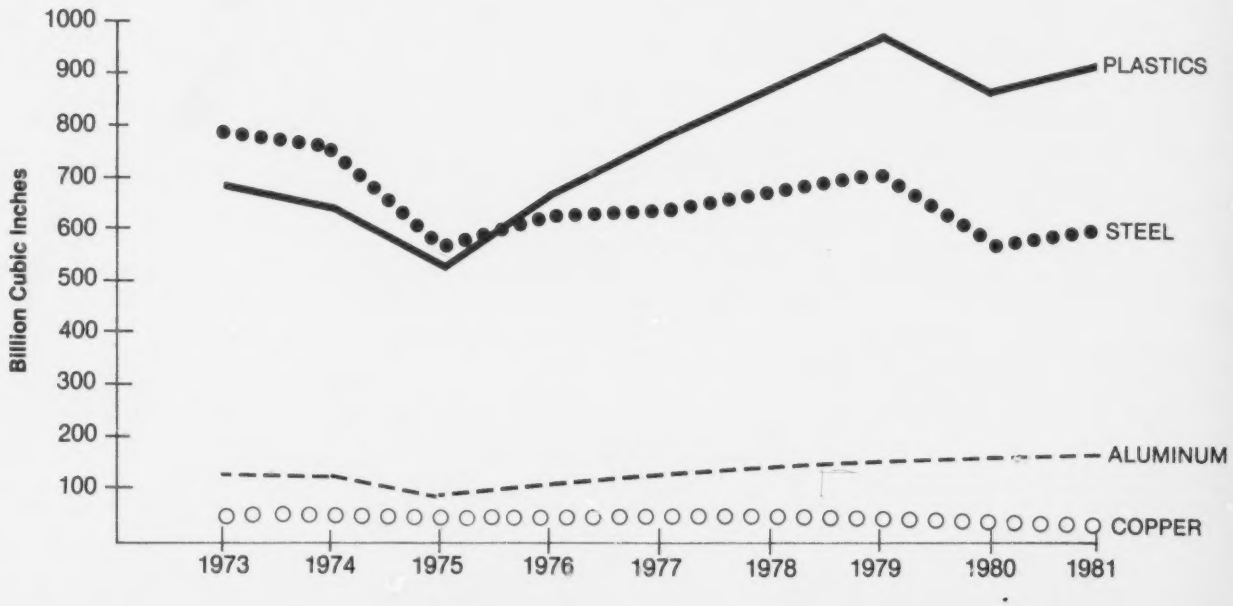
PLASTICS MATERIALS & RESINS
VALUE OF SHIPMENTS
(in millions of dollars)

Versus Largest Chemical Categories	1977	1978	1979	1980	1981	Compound Growth Rate 1976-1981
Industrial Organic Chemicals	24,200	26,350	32,700	37,900	41,800	15.2%
Drugs	14,250	16,300	17,300	19,400	22,650	11.7%
Plastics Materials & Resins	10,800	12,000	14,300	15,500	17,500	9.4%
Industrial Inorganic Chemicals	8,700	9,800	10,600	11,500	13,000	12.0%
Cosmetics	6,550	7,200	7,400	8,850	10,000	11.2%
Paints & Allied Products	6,600	7,150	7,900	8,700	9,300	9.4%
Cyclic Crudes & Intermediates	5,650	5,700	6,250	8,100	9,200	14.5%
Soaps & Detergents	5,650	6,400	6,900	7,850	8,850	11.2%
Phosphatic Fertilizers	2,700	2,850	3,500	3,950	4,200	11.5%
Nitrogenous Fertilizers	2,600	2,650	2,650	3,050	3,350	7.0%

Versus Other Commodities	1977	1978	1979	1980	1981	Compound Growth Rate 1976-1981
Steel	49,650	58,050	65,950	60,750	72,000	17.1%
Paper and Board	20,200	22,900	25,450	29,800	35,200	13.2%
Aluminum	13,100	15,900	18,900	19,900	20,200	13.1%
Cement and Concrete	13,350	15,950	18,150	18,050	18,450	10.1%
Plastics Materials & Resins	10,800	12,000	14,300	15,550	17,500	9.4%
Refined Copper	3,900	4,200	5,750	5,450	5,350	8.5%
Glass Containers	3,650	4,050	4,200	4,600	5,000	8.6%
Synthetic Rubber	1,850	2,000	2,650	2,500	3,175	13.3%
Leather Tanning & Finishing	1,450	1,575	1,800	1,900	2,175	10.4%
Primary Leads	700	850	1,350	875	820	2.9%

Source: Department of Commerce estimates.

SHIPMENTS BY VOLUME: PLASTICS VS. METALS



NOTE: Factors used in conversion—steel = .289 lbs/cu in
plastics = .04 lbs/cu in
aluminum = .098 lbs/cu in
copper = .321 lbs/cu in

NOTE: Plastics do not include polyurethane
SOURCE: American Iron and Steel Institute
SPI
U.S. Bureau of the Census

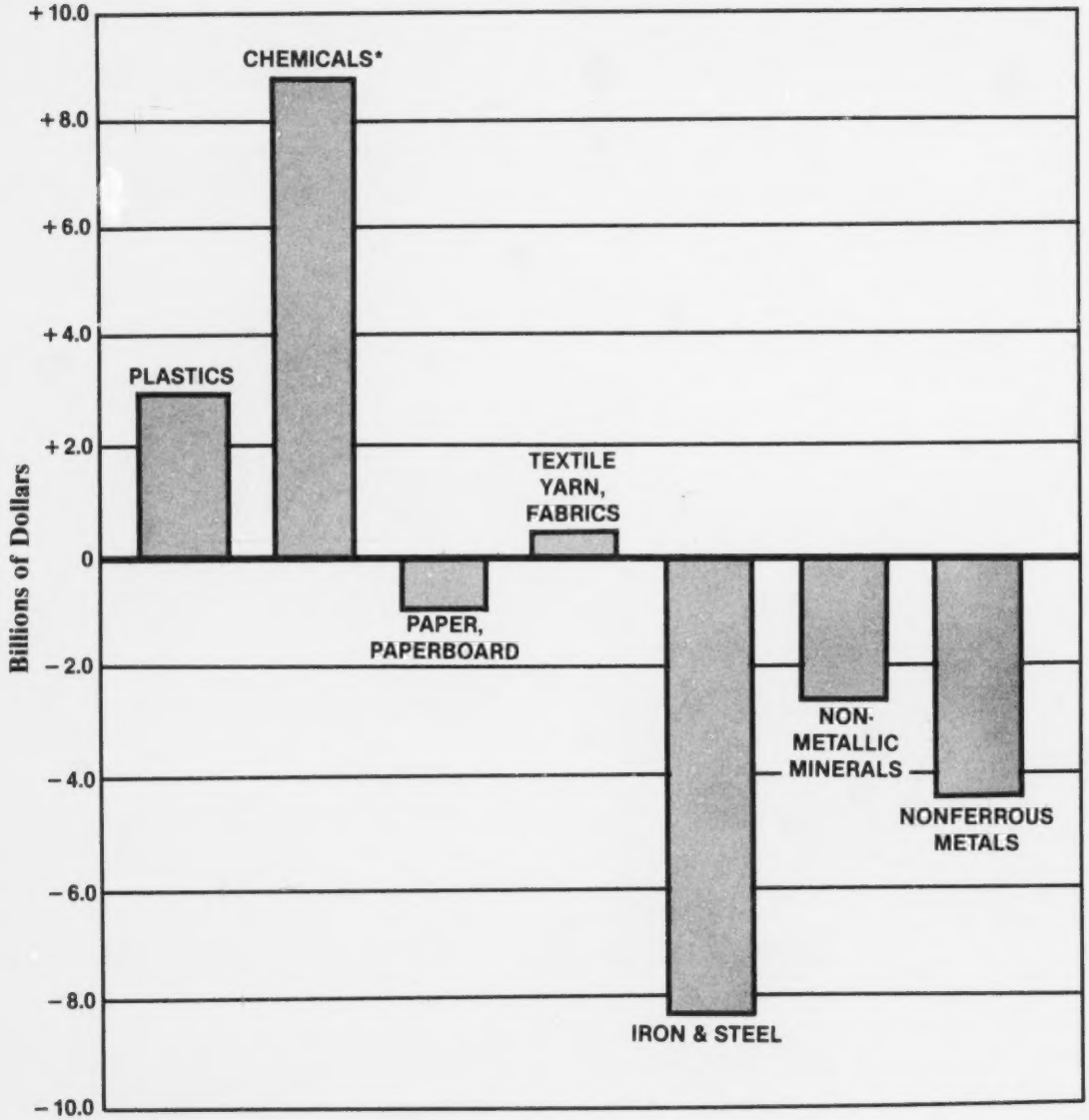
GENERAL ECONOMIC STATISTICS

COMMODITY — BALANCE OF TRADE
(in millions of dollars)

	Exports	Imports	Difference
Plastics Materials & Resins			
1977	1,733	401	+1,332
1978	2,088	566	+1,522
1979	3,240	641	+2,599
1980	3,884	652	+3,232
1981	3,809	779	+3,030
Chemicals (except plastics)			
1977	9,094	5,057	+4,037
1978	10,530	6,212	+4,318
1979	14,066	6,877	+7,189
1980	16,356	7,891	+8,465
1981	17,378	8,543	+8,835
Paper, Paperboard			
1977	1,517	2,405	−888
1978	1,597	3,024	−1,427
1979	1,967	3,331	−1,364
1980	2,831	3,534	−703
1981	2,961	3,822	−861
Textile Yarn, Fabrics			
1977	1,959	1,790	+169
1978	2,225	2,400	−175
1979	3,189	2,237	+952
1980	3,632	2,504	+1,128
1981	3,619	3,043	+576
Iron and Steel			
1977	1,660	5,993	−4,333
1978	1,714	8,034	−6,320
1979	2,342	7,620	−5,278
1980	3,122	7,509	−4,387
1981	2,880	11,238	−8,358
Nonmetallic Minerals, n.e.c.			
1977	1,275	2,815	−1,540
1978	1,597	4,086	−2,489
1979	1,949	4,065	−2,116
1980	2,209	4,680	−2,471
1981	2,194	4,890	−2,696
Nonferrous Metals			
1977	1,150	3,946	−2,796
1978	1,281	5,259	−3,978
1979	2,152	6,314	−4,162
1980	4,743	7,612	−2,869
1981	2,594	6,947	−4,353

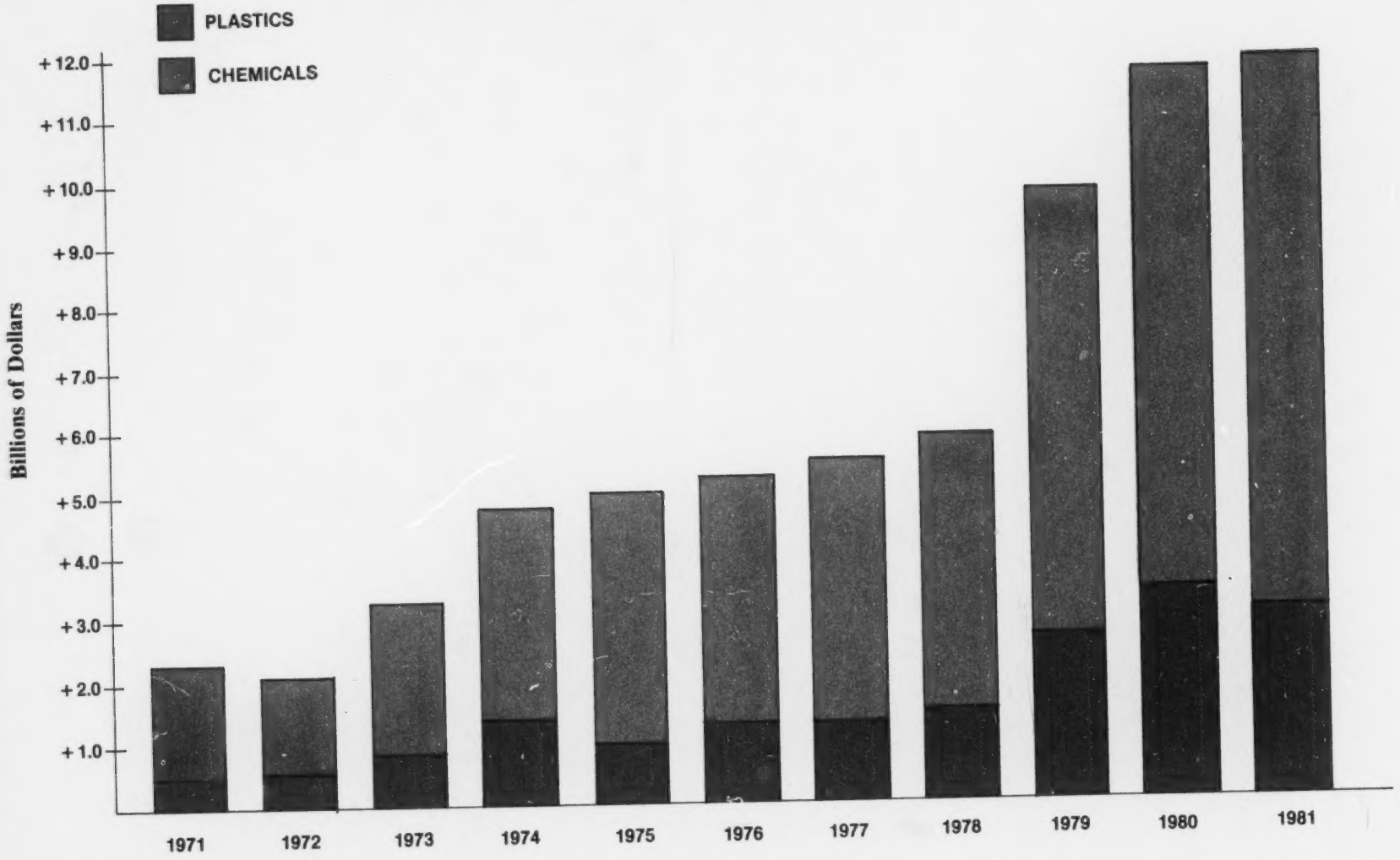
Source: U.S. Dept. of Commerce; FT 135(U.S. Imports), FT 410(U.S. Exports)

U.S. BALANCE OF TRADE—1981



Source: Department of Commerce
*Chemicals exclude plastics

PLASTICS & CHEMICALS BALANCE OF TRADE 1971-1981



PRODUCER PRICE INDEXES
[1967 = 100]

YEAR	NON-METALLIC MINERAL PRODUCTS	METALS & METAL PRODUCTS	INDUSTRIAL COMMODITIES	CHEMICALS & ALLIED PRODUCTS	PLASTICS RESINS & MATERIALS
	COMMODITY GROUP				
1968	103.7	102.6	102.5	99.8	91.9
1969	107.7	108.5	106.0	99.9	90.4
1970	113.3	116.7	110.0	102.2	90.7
1971	122.4	119.0	114.0	104.2	88.9
1972	126.1	123.5	117.9	104.2	88.7
1973	130.2	132.8	125.9	110.0	92.1
1974	153.2	171.9	153.8	146.8	143.8
1975	174.0	185.6	171.5	181.3	180.9
1976	186.3	195.9	182.4	187.2	194.0
1977	200.5	209.0	195.1	192.8	197.5
1978	228.8	227.1	209.4	198.8	199.9
1979	248.6	259.3	236.5	222.3	235.9
1980	282.9	286.4	274.3	260.3	279.5
1981	309.5	300.4	304.1	287.7	289.2

Source: Bureau of Labor Statistics, U.S. Department of Labor.

WHAT IS SIC?

The Standard Industrial Classification System (SIC) classifies all manufacturing and services produced in the U.S. It starts with the broadest industrial aggregations; then, by a series of subdivisions, it identifies more finely detailed classes or groupings right down to the individual product level. Thus at the first level there is the manufacturing sector. At the next level of detail, manufacturing is divided into twenty 2-digit *Major Groups,* such as SIC 28, CHEMICALS. Those are subdivided into 3-digit *Industry Groups,* of which there are 143, such as 282, plastics and synthetic fibers.

The next level is made up of 4-digit *Specific Industries,* of which there are 457, including SIC 2821, plastics resins and materials. This level of detail is the one used in the "Survey of Industrial Purchasing Power."

A complete list of industries, and their definitions, appears in the "Standard Industrial Classification Manual," available from the U.S. Government Printing Office, Washington, D.C. 20402; price $6.75.

The basic reporting unit in the SIC is the individual establishment, such as a factory, plant or mill, engaged primarily in manufacturing products and thus distinguished from a central administrative office or other auxiliary units. Also, an establishment is not necessarily identical with the business firm, which may consist of more than one such facility.

1981

SIC	Industry	Number of Plants		Shipments ($Mil.)
		Total Plants	Employment	
SIC 28 Chemicals				
2812	Alkalies & chlorine	71	19,437	2,425.1
2813	Industrial gases	353	17,580	1,833.1
2816	Inorganic pigments	92	11,878	1,830.0
2819	Industrial inorganic chemicals n.e.c.	554	93,689	12,425.6
2821	**Plastics materials & synthetic resins**	487	90,455	16,357.8
2822	Synthetic rubber	46	21,898	2,868.5
2823	Cellulosic man-made fibers	11	20,810	1,592.7
2824	Noncellulosic synthetic organic fibers	57	64,449	10,135.9
2831	Biological products	90	12,277	1,296.2
2833	Medicinals & botanicals	104	21,880	2,924.8
2834	Pharmaceutical preparations	468	129,925	16,432.6
2841	Soap & other detergents	269	36,620	7,881.4
2842	Polishes & sanitation goods	527	41,486	4,355.2
2843	Surface-active agents	73	5,432	1,598.0
2844	Toilet preparations	256	58,739	9,138.5
2851	Paints & allied products	892	71,381	10,119.8
2861	Gum & wood chemicals	82	6,467	604.8
2865	Cyclic crudes & intermediates	194	29,091	7,815.2
2869	Industrial organic chemicals n.e.c.	511	109,643	34,759.1
2873	Nitrogenous fertilizers	213	19,063	3,955.7
2874	Phosphatic fertilizers	89	17,071	4,206.9
2875	Fertilizers—mixing only	298	13,983	2,952.0
2879	Agricultural chemicals n.e.c.	167	8,685	4,443.6
2891	Adhesives & sealants	307	26,415	3,133.1
2892	Explosives	65	12,182	1,054.8
2893	Printing ink	217	12,307	1,505.3
2895	Carbon black	34	3,309	738.9
2899	Chemical preparations n.e.c.	706	54,276	6,350.1
SIC 30 Rubber & misc. plastics				
3011	Tires & inner tubes	127	82,172	10,893.2
3021	Rubber & plastic footwear	43	20,098	628.3
3031	Reclaimed rubber	17	957	47.8
3041	Rubber & plastic hose & belting	171	31,301	1,672.0
3069	Fabricated rubber products n.e.c.	889	121,301	4,901.3
3079	**Miscellaneous plastics products**	4,803	424,666	27,312.9

Source: *Sales & Marketing Management's 1982 Survey of Industrial Purchasing Power, U.S. Dept. of Commerce.*

PROFILE OF 50 BIGGEST MANUFACTURING INDUSTRIES

1981 Rank	SIC	Industry	1981 Shipments ($ Mil.)	Total Plants	Shipments Per Plant ($000)	% Shipments Large Plants
1.	2911	Petroleum refining	$175,608	343	$511,976	91%
2.	3711	Motor vehicles & car bodies	87,860	168	522,974	99
3.	3312	Blast furnaces & steel mills	57,146	350	163,273	98
4.	2011	Meat packing plants	42,467	1,052	40,368	79
5.	3714	Motor vehicle parts & accessories	41,229	1,234	33,411	93
6.	2869	Industrial organic chemicals, n.e.c.	34,759	511	68,022	88
7.	3573	Electronic computing equipment	29,219	581	50,290	95
8.	**3079**	**Misc. plastics products**	27,313	4,803	5,687	65
9.	3721	Aircraft	24,913	119	209,355	99
10.	3662	Radio & tv communication equipment	24,083	1,153	20,887	89
11.	3585	Refrigeration & heating equipment	20,920	546	38,315	89
12.	3531	Construction machinery	20,554	492	41,777	92
13.	2621	Paper mills, except building paper	18,975	339	55,973	97
14.	2711	Newspapers	18,286	2,497	7,323	76
15.	2026	Fluid milk	18,008	1,013	17,777	68
16.	3861	Photographic equip. & supplies	16,642	398	41,815	86
17.	2834	Pharmaceutical preparations	16,433	468	35,112	92
18.	**2821**	**Plastics materials & resins**	16,358	487	33,589	85
19.	2086	Bottled & canned soft drinks	14,708	1,647	8,930	56
20.	3465	Automotive stamping	13,849	195	71,023	96
21.	2421	Sawmills & planing mills, general	13,577	2,041	6,652	56
22.	3599	Nonelectrical machinery, n.e.c.	13,337	3,248	4,106	34
23.	2752	Commercial printing, lithographic	13,323	1,901	7,008	52
24.	3661	Telephone & telegraphic apparatus	13,024	220	59,201	97
25.	3523	Farm machinery & equipment	12,430	887	14,014	81
26.	2819	Industrial inorganic chemicals, n.e.c.	12,426	554	22,429	84
27.	3731	Ship building & repairing	11,959	340	35,174	95
28.	2013	Sausages & other prepared meats	11,821	760	15,554	71
29.	3724	Aircraft engines & engine parts	11,816	163	72,493	96
30.	2048	Prepared feeds, n.e.c.	11,592	1,027	11,287	33
31.	2051	Bread, cake & related products	11,471	1,411	8,130	82
32.	3519	Internal combustion engines, n.e.c.	11,440	125	91,519	97
33.	3011	Tires & inner tubes	10,893	127	85,773	97
34.	2631	Paperboard mills	10,705	202	52,995	94
35.	2075	Soybean oil mills	10,435	80	130,440	50
36.	2653	Corrugated & solid fiber boxes	10,353	1,118	9,260	74
37.	2824	Organic fibers, noncellulosic	10,136	57	177,823	99
38.	2851	Paints & allied products	10,120	892	11,345	61
39.	3443	Fabricated plate work, boiler shops	9,975	1,230	8,110	73
40.	2082	Malt beverages	9,815	86	114,133	98
41.	2022	Cheese, natural & processed	9,633	324	29,730	65
42.	2111	Cigarettes	9,503	12	791,933	100
43.	3679	Electronic components, n.e.c.	9,481	1,633	5,806	80
44.	3674	Semiconductors & related devices	9,418	293	32,142	95
45.	2844	Toilet preparations	9,139	256	35,697	91
46.	3273	Ready-mixed concrete	9,035	1,567	5,766	33
47.	3651	Radio & TV receiving sets	8,650	268	32,278	93
48.	2721	Periodicals	8,558	947	9,037	66
49.	3411	Metal cans	8,557	351	24,379	89
50.	3321	Gray iron foundries	8,527	773	11,030	84
		50-industry total	**$1,040,478**	**41,289**	**$25,200**	**86%**

N.A.: Not available. n.e.c.: Not elsewhere classified.

Definitions: **Shipments:** Output of all manufacturing plants. **No. of Plants:** Manufacturing establishments with 20 or more employees.

Average Shipments per plant: A mathematical average, computed by dividing number of plants into total shipments. % Large Plants: Share of shipments accounted for by plants with 100 or more employees.

Sources: *Sales & Marketing Management's 1982 Survey of Industrial Purchasing Power,* U.S. Commerce Dept., *U.S. Industrial Outlook 1982.*

INDUSTRY FINANCIAL PERFORMANCE — 1981

RETURN ON SALES
THE INDUSTRY MEDIANS

	1981	1980
Mining, crude-oil production	11.7%	9.2%
Pharmaceuticals	9.1	9.1
Tobacco	7.9	7.9
Publishing, printing	7.1	6.2
Measuring, scientific, photographic equipment	6.9	6.9
Office equipment (includes computers)	6.1	6.0
Beverages	5.5	4.8
Chemicals	5.4	5.2
Paper, fiber, and wood products	5.0	5.0
Soaps, cosmetics	5.0	5.9
Industrial and farm equipment	4.6	4.3
Shipbuilding, railroad and transportation equipment	4.5	4.1
Metal manufacturing	4.4	4.1
Petroleum refining	4.4	5.5
Metal products	4.4	4.7
Electronics, appliances	4.4	5.3
Aerospace	4.0	4.1
Apparel	3.4	3.6
Musical instruments, toys, sporting goods	3.4	3.7
Glass, concrete, abrasives, gypsum	3.1	3.7
Rubber, plastic products	3.0	1.5
Textiles, vinyl flooring	2.9	2.8
Motor vehicles	2.8	2.6
All industries	4.6	4.8
Custom Processors	2.4	
Proprietary Processors	2.1	
All Processors	2.1	

CHANGES IN SALES
THE INDUSTRY MEDIANS

Mining, crude-oil production	19.5 %
Petroleum refining	15.3
Publishing, printing	14.2
Musical instruments, toys, sporting goods	13.7
Office equipment (includes computers)	12.7
Aerospace	10.9
Measuring, scientific, photographic equipment	9.6
Tobacco	9.1
Rubber, plastic products	9.1
Apparel	8.9
Electronics, appliances	8.6
Pharmaceuticals	8.1
Chemicals	7.9
Metal manufacturing	7.2
Metal products	6.8
Beverages	6.8
Motor vehicles	6.7
Soaps, cosmetics	6.7
Industrial and farm equipment	6.6
Shipbuilding, railroad and transportation equipment	6.3
Paper, fiber, and wood products	5.8
Textiles, vinyl flooring	4.0
Glass, concrete, abrasives, gypsum	3.9
Custom Processors	6.7 (1980)
Proprietary Processors	9.0 (1980)
All Processors	7.8 (1980)

SALES PER EMPLOYEE
THE INDUSTRY MEDIANS

Petroleum refining	$512,868
Mining, crude-oil production	302,784
Beverages	139,272
Chemicals	119,395
Food	114,979
Metal manufacturing	107,165
Paper, fiber, and wood products	102,481
Soaps, cosmetics	97,965
Tobacco	95,286
Pharmaceuticals	81,745
Glass, concrete, abrasives, gypsum	80,963
Rubber, plastic products	78,806
Motor vehicles	78,790
Publishing, printing	77,860
Industrial and farm equipment	76,804
Shipbuilding, railroad and transportation equipment	76,673
Metal products	75,677
Aerospace	70,175
Musical instruments, toys, sporting goods	67,690
Measuring, scientific, photographic equipment	62,499
Electronics, appliances	60,385
Office equipment (includes computers)	54,304
Textiles, vinyl flooring	51,161
Apparel	42,135
All industries	86,381
Custom Processors	49,840 (1980)
Proprietary Processors	54,592 (1980)
All Processors	51,113 (1980)

TOTAL RETURN TO INVESTORS
THE INDUSTRY MEDIANS

Apparel	37.73%
Beverages	31.85
Musical instruments, toys, sporting goods	27.06
Soaps, cosmetics	22.32
Rubber, plastic products	21.09
Food	18.15
Textiles, vinyl flooring	15.65
Publishing, printing	15.53
Metal products	8.06
Tobacco	5.95
Glass, concrete, abrasives, gypsum	3.40
Pharmaceuticals	3.07
Electronics, appliances	.39
Chemicals	– .95
Paper, fiber, and wood products	– 4.13
Motor vehicles	– 4.45
Metal manufacturing	– 6.08
Shipbuilding, railroad and transportation equipment	– 6.24
Industrial and farm equipment	– 10.29
Measuring, scientific, photographic equipment	– 10.38
Office equipment (includes computers)	– 18.61
Aerospace	– 21.93
Petroleum refining	– 23.17
Mining, crude-oil production	– 23.90
All industries	– .35
Custom Processors	9.8 (1980)
Proprietary Processors	7.6 (1980)
All Processors	8.7 (1980)

Source: "The Fortune Directory of the 500 Largest U.S. Industrial Corporations"
SPI Financial Management Committee, Financial and Operating Ratios Survey

INDUSTRY FINANCIAL PERFORMANCE — 1981

TOTAL RETURN TO INVESTORS, 1971-81
THE INDUSTRY MEDIANS

Aerospace	15.86%
Mining, crude-oil production	15.43
Shipbuilding, railroad and transportation equipment	14.00
Petroleum refining	13.44
Tobacco	13.33
Metal manufacturing	11.93
Publishing, printing	9.75
Metal products	8.96
Industrial and farm equipment	8.91
Chemicals	8.58
Paper, fiber, and wood products	8.12
Food	7.49
Electronics, appliances	6.91
Measuring, scientific, photographic equipment	6.32
Glass, concrete, abrasives, gypsum	5.85
Apparel	5.76
Pharmaceuticals	5.30
Office equipment (includes computers)	4.88
Motor vehicles	4.81
Textiles, vinyl flooring	3.77
Rubber, plastic products	3.40
Soaps, cosmetics	2.75
Beverages	1.32
Musical instruments, toys, sporting goods	– 2.50
All industries	8.52
Custom Processors	– 14.8 (1970-80)
Proprietary Processors	– 18.2 (1970-80)
All Processors	– 16.6 (1970-80)

CHANGES IN PROFITS
THE INDUSTRY MEDIANS

	INCREASES
Rubber, plastic products	62.0%
Musical instruments, toys, sporting goods	52.8
Apparel	19.1
Aerospace	16.3
Beverages	15.1
Publishing, printing	13.5
Office equipment (includes computers)	13.0
Industrial and farm equipment	12.7
Measuring, scientific, photographic equipment	12.4
Food	10.6
Tobacco	10.2
Chemicals	10.1
Metal products	8.8
Electronics, appliances	8.8
Motor vehicles	8.0
Pharmaceuticals	6.2
Shipbuilding, railroad and transportation equipment	6.2
Metal manufacturing	4.3
Paper, fiber, and wood products	4.0
Mining, crude-oil production	1.6

	DECREASES
Glass, concrete, abrasives, gypsum	15.1%
Petroleum refining	7.6
Textiles, vinyl flooring	3.1
Soaps, cosmetics	1.8
Custom Processors	28.9 (1980)
Proprietary Processors	52.4 (1980)
All Processors	44.3 (1980)

ASSETS PER EMPLOYEE
THE INDUSTRY MEDIANS

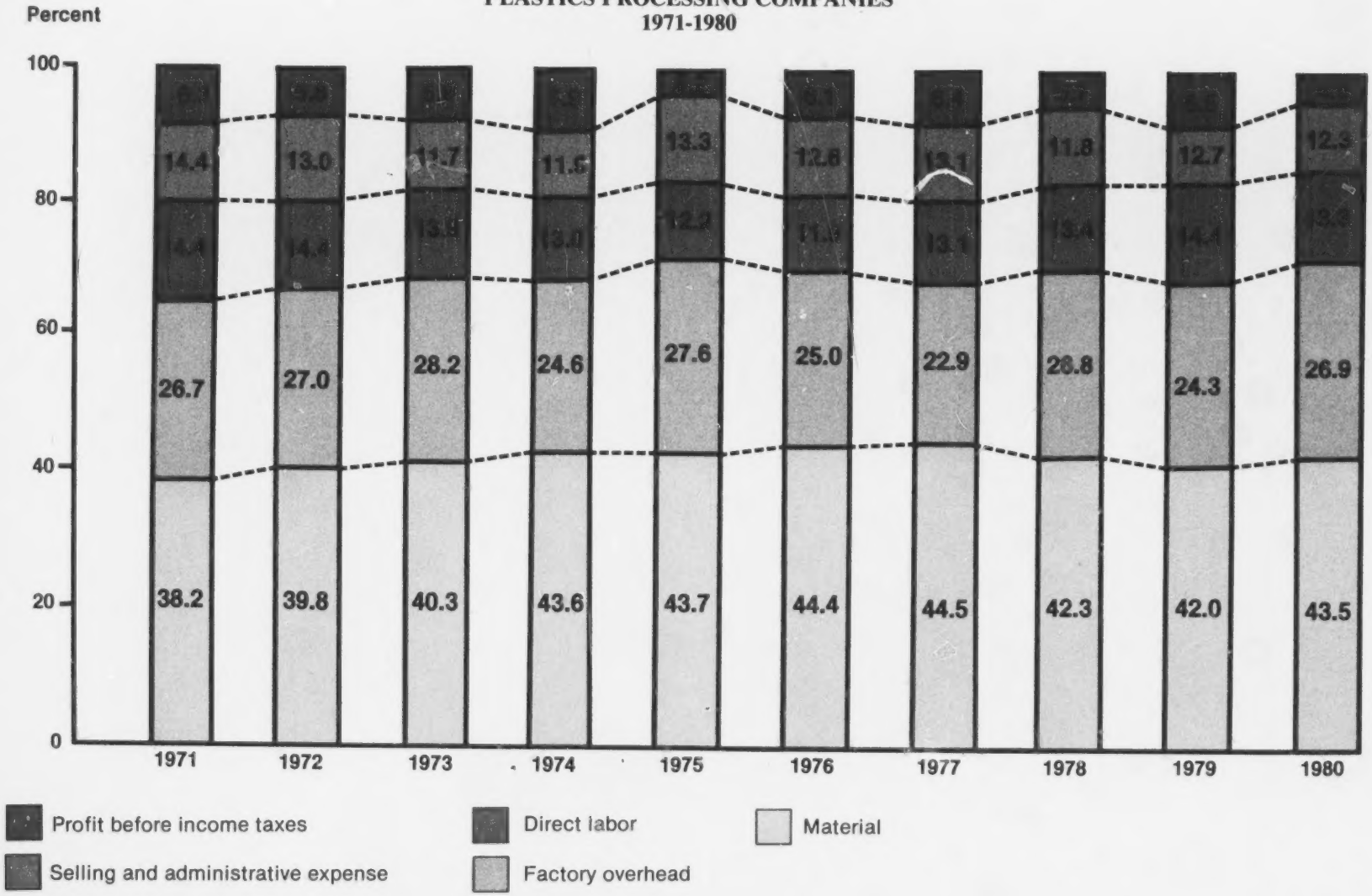
Mining, crude-oil production	$383,787
Petroleum refining	314,801
Beverages	95,828
Chemicals	94,299
Paper, fiber, and wood products	92,023
Metal manufacturing	82,380
Tobacco	78,730
Pharmaceuticals	74,388
Glass, concrete, abrasives, gypsum	64,337
Publishing, printing	57,924
Industrial and farm equipment	57,258
Soaps, cosmetics	57,175
Food	56,941
Office equipment (includes computers)	54,858
Metal products	53,151
Shipbuilding, railroad and transportation equipment	52,104
Motor vehicles	51,786
Rubber, plastic products	48,061
Aerospace	46,689
Electronics, appliances	46,216
Measuring, scientific, photographic equipment	45,935
Musical instruments, toys, sporting goods	44,610
Textiles, vinyl flooring	30,227
Apparel	23,278
All industries	60,437
Custom Processors	26,370 (1980)
Proprietary Processors	36,504 (1980)
All Processors	31,437 (1980)

RETURN ON STOCKHOLDERS' EQUITY
THE INDUSTRY MEDIANS

	1981	1980
Tobacco	19.5%	19.8%
Beverages	19.2	15.6
Pharmaceuticals	18.0	17.9
Mining, crude-oil production	17.6	21.0
Publishing, printing	16.4	15.9
Petroleum refining	16.4	19.4
Apparel	16.2	12.8
Soaps, cosmetics	15.8	16.9
Measuring, scientific, photographic equipment	15.6	17.1
Aerospace	15.0	16.2
Food	14.4	14.5
Shipbuilding, railroad and transportation equipment	14.4	14.4
Electronics, appliances	14.3	16.2
Metal products	14.1	15.3
Industrial and farm equipment	13.9	13.3
Chemicals	13.5	13.9
Office equipment (includes computers)	13.3	15.1
Metal manufacturing	12.4	12.9
Paper, fiber, and wood products	12.0	12.8
Rubber, plastic products	10.4	5.0
Glass, concrete, abrasives, gypsum	9.6	11.3
Musical instruments, toys, sporting goods	9.2	12.6
Textiles, vinyl flooring	7.8	8.1
Motor vehicles	7.6	8.1
All industries	13.8	14.4
Custom Processors	10.2	
Proprietary Processors	10.0	
All Processors	10.1	

Source: "The Fortune Directory of the 500 Largest U.S. Industrial Corporations"
SPI Financial Management Committee, Financial and Operating Ratios Survey

TREND IN DISTRIBUTION OF SALES DOLLAR
PLASTICS PROCESSING COMPANIES
1971-1980



SALES OF MAJOR U.S. PLASTICS PRODUCING COMPANIES
(rounded to nearest $25 million)

	Plastics Sales[1]		Chemicals Sales[2]		Total Sales	
Company[3]	1981	1980	1981	1980	1981	1980
1 Dow Chemical	3,225	3,275	7,650	7,625	11,875	10,625
2 DuPont[a]	3,200	3,000	5,575	5,150	22,800	13,750
3 Dart & Kraft	1,900	1,875	1,900	1,875	10,200	9,400
4 Monsanto	1,375	1,375	5,300	4,950	6,950	6,575
5 Union Carbide	1,150	1,100	3,800	3,650	10,150	10,000
6 Standard Oil (Indiana)	900	900	3,225	3,025	31,725	27,825
7 Hercules	750	700	2,275	2,100	2,725	2,475
8 Shell Oil	700	575	3,475	3,100	21,750	19,950
9 B.F. Goodrich	675	625	1,050	1,025	3,175	3,075
10 Celanese	650	450	1,700	1,475	3,750	3,350
11 Gulf Oil	575	550	2,400	2,450	30,450	28,800
12 Exxon	500	500	8,450	8,225	113,200	108,450
12 Occidental Petroleum	500	400	2,400	2,425	15,350	12,725
14 Atlantic Richfield	475	500	2,750	2,250	28,200	24,150
14 Phillips Petroleum	475	475	2,475	2,250	16,275	13,700
16 Borg Warner	425	450	650	625	2,750	2,675
16 Ethyl	425	425	1,525	1,525	1,750	1,750
16 General Electric	425	400	425	400	27,250	24,950
19 W.R. Grace	400	400	3,050	3,025	6,525	6,125
20 Rohm and Haas	375	350	1,750	1,600	1,875	1,725
21 U.S. Steel	325	375	1,500	1,475	13,950	12,500
21 Goodyear Tire & Rubber	325	300	1,050	1,000	9,150	8,450
23 Eastman Kodak	250	200	2,350	2,075	10,325	9,725
24 Reichhold Chemicals	225	225	825	800	950	875
24 Certain Teed	225	225	225	225	900	875
24 Internorth	225	200	375	350	3,650	3,025
27 Allied	200	200	2,650	2,450	6,400	5,525
27 National Distillers	200	225	850	825	2,025	2,050
29 Tenneco	175	200	1,875	1,650	15,450	13,225
29 Borden	175	175	1,425	1,550	4,425	4,600
31 Air Products & Chemicals	125	125	550	525	1,575	1,425

Note: There are several foreign-based companies which could be listed above had data been available.

[a] Includes data from Conoco acquisition for 5 months.

[1] Includes fabricated plastics products.

[2] Includes plastics.

[3] Ranked by plastics sales in 1981.

Source: Company annual reports, industry estimates.

PROPRIETARY PROCESSORS BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	Operating Statements	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
2.3	1.4	0.5	Freight Out & Warehousing	1.6	1.8	2.0
2.6	2.0	1.4	Direct Packaging & Shipping Supplies	2.6	2.4	2.2
44.6	39.9	34.9	Direct Materials	45.4	44.4	40.6
10.8	11.0	11.1	Direct Labor	10.8	10.5	10.2
5.7	5.6	5.4	Indirect Labor	8.8	7.9	7.1
3.0	2.7	2.1	Utilities	2.7	2.6	2.6
3.4	3.7	3.9	Other Variable Mfg. Expense	5.2	5.0	4.7
4.5	3.8	3.0	Depreciation Expense	3.1	2.9	2.7
2.1	1.6	1.1	Lease Expense	0.5	0.8	1.1
1.5	1.9	2.2	Other Fixed Mfg. Expense	1.5	1.5	1.6
0.4	0.6	0.8	Net on Tool Transactions	(0.3)	(0.1)	0.2
1.1	2.7	4.3	Sales Commissions	1.4	2.0	2.5
4.2	4.2	4.2	Other Sales Expense	4.0	4.6	5.2
8.7	8.1	7.5	Administrative Expense	6.3	6.1	5.9
5.1	10.8	17.6	Operating Earnings	6.4	7.6	11.4
N.A.	2.1	4.2	Engineering Expense	3.4	1.6	1.2
3.3	2.9	2.5	Research & Development Expense	0.5	0.7	1.0
1.5	1.4	1.3	Interest	1.7	1.1	0.6
2.1	1.3	0.5	Misc. (Income) or Expense	(1.2)	(0.6)	0.1
(1.8)	3.1	9.1	Profit Before Income Taxes	2.0	4.8	8.5
(0.4)	1.3	4.7	Federal Income Tax	0.6	1.8	3.0
0.1	0.3	0.6	Other Income Taxes	0.1	0.3	0.8
(1.5)	1.5	3.8	PROFIT AFTER INCOME TAXES	1.3	2.7	4.7
118.0%	128.8%	139.5%	Sales as Percentage of Total Assets	178.6%	170.3%	162.0%
			Balance Sheets			
1.7	2.8	3.9	Cash & Equivalents	0.9	2.2	3.4
21.9	22.8	23.3	Accounts & Notes Receivable	22.3	23.7	25.1
6.4	8.2	10.5	Raw Material Inventory	8.6	8.1	7.7
10.7	7.0	3.3	Work in Process Inventory	4.0	3.5	2.9
3.3	5.8	7.3	Finished Goods Inventory	11.5	13.7	16.0
2.1	2.4	2.5	LIFO Reserve	8.2	7.6	6.9
0.2	0.2	0.2	Packaging & Shipping Supplies	1.4	1.2	1.0
0.7	1.1	1.6	Other Current Assets	2.4	2.3	2.1
42.8	45.5	47.6	CURRENT ASSETS	42.9	47.1	51.3
26.3	25.8	25.4	Land & Buildings, at Cost	24.9	23.6	22.3
4.7	5.6	6.4	Depreciation Reserve	7.0	6.9	6.8
55.0	47.8	41.1	Machinery & Equipment, at Cost	54.1	49.6	45.1
24.0	16.9	9.7	Depreciation Reserve	22.0	21.8	21.5
5.7	5.0	4.2	Molds, Tools, & Dies, at Cost	5.1	9.5	13.8
4.6	3.9	3.3	Depreciation Reserve	3.4	5.8	8.2
3.5	2.3	1.1	Other Long-Term Assets	5.4	4.7	4.0
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
1.1	1.7	2.3	Current Portion of Term Debt	2.8	2.2	1.5
12.3	8.0	3.7	Notes Payable	19.8	11.5	3.2
11.2	10.2	9.2	Accounts Payable, Trade	8.7	7.9	7.1
6.8	6.3	5.7	Other Payables & Accruals	6.6	6.5	6.4
(0.6)	2.1	4.8	Provision for Income Taxes	2.7	3.6	4.5
30.8	28.3	25.7	CURRENT LIABILITIES	40.6	31.7	22.7
38.0	25.5	13.1	Real Estate Mortgages	5.5	9.0	12.6
4.2	8.5	12.7	Other Long-Term Debt	16.4	13.3	10.1
73.0	62.3	51.5	TOTAL LIABILITIES	62.5	54.0	45.4
27.0	37.7	48.5	EQUITY (NET WORTH)	37.5	46.0	54.6

*Less Profitable: Profit Before Income Tax to Net Sales less than 3.1%.
More Profitable: Profit Before Income Tax to Net Sales equal to or more than 3.1%.
**Less Profitable: Profit Before Income Tax to Net Sales less than 4.8%.
More Profitable: Profit Before Income Tax to Net Sales equal or greater than 4.8%.

CUSTOM PROCESSORS BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION				SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*	Operating Statements	Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.5	0.6	0.7	Freight Out & Warehousing	1.1	1.0	0.8
2.0	2.0	1.9	Direct Packaging & Shipping Supplies	2.8	2.2	1.6
36.0	35.9	35.8	Direct Materials	46.9	45.6	44.3
16.3	15.6	14.6	Direct Labor	10.4	11.2	12.0
8.6	8.9	9.2	Indirect Labor	9.2	7.8	6.3
3.3	3.1	2.9	Utilities	2.8	2.6	2.4
7.1	6.3	4.9	Other Variable Mfg. Expense	4.9	5.0	5.0
3.1	2.9	2.6	Depreciation Expense	3.3	2.8	2.3
1.5	1.4	1.4	Lease Expense	0.8	0.7	0.7
1.8	1.8	1.8	Other Fixed Mfg. Expense	1.4	1.4	1.4
1.0	0.3	(0.4)	Net on Tool Transactions	(0.3)	0.2	0.6
1.7	1.4	1.0	Sales Commissions	1.0	1.5	2.0
2.2	2.4	2.6	Other Sales Expense	2.5	2.4	2.4
10.4	9.7	8.0	Administrative Expense	8.3	7.4	6.3
4.5	7.7	13.0	Operating Earnings	4.9	8.2	11.9
N.A.	1.2	2.4	Engineering Expense	1.1	1.6	2.2
2.5	1.8	1.0	Research & Development Expense	0.5	0.7	1.0
1.3	1.0	0.7	Interest	2.0	1.2	0.3
0.6	0.3	0.1	Misc. (Income) or Expense	(0.1)	0.0	0.1
0.1	3.4	8.8	Profit Before Income Taxes	1.4	4.7	8.3
(0.1)	0.9	2.2	Federal Income Tax	0.5	1.9	3.4
0.1	0.3	0.6	Other Income Taxes	0.2	0.3	0.6
0.1	2.2	6.0	PROFIT AFTER INCOME TAXES	0.7	2.5	4.3
205.8%	194.6%	183.3%	Sales as Percentage of Total Assets	186.5%	183.4%	180.3%
			Balance Sheets			
2.7	3.7	4.7	Cash & Equivalents	1.3	4.1	6.9
26.3	27.3	28.3	Accounts & Notes Receivable	23.9	25.6	27.3
11.3	11.3	11.3	Raw Material Inventory	9.7	9.8	9.8
9.8	8.2	6.5	Work in Process Inventory	3.7	3.8	4.0
5.8	5.2	4.6	Finished Goods Inventory	5.8	8.6	11.3
3.4	3.0	2.7	LIFO Reserve	3.2	4.8	6.5
1.1	0.9	0.7	Packaging & Shipping Supplies	1.2	1.1	1.0
3.1	2.4	1.8	Other Current Assets	1.6	1.5	1.4
56.7	56.0	55.2	CURRENT ASSETS	44.0	49.7	55.2
13.1	19.5	25.8	Land & Buildings, at Cost	23.5	23.4	23.3
5.0	5.3	5.5	Depreciation Reserve	6.8	6.6	6.4
64.7	56.5	49.2	Machinery & Equipment, at Cost	58.1	54.4	50.7
32.8	30.6	29.0	Depreciation Reserve	25.1	27.5	29.8
4.5	3.3	2.1	Molds, Tools, & Dies, at Cost	3.2	3.3	3.4
3.6	2.3	1.1	Depreciation Reserve	1.7	2.4	3.1
2.4	2.9	3.3	Other Long-Term Assets	4.8	5.7	6.7
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
3.3	3.2	3.0	Current Portion of Term Debt	3.0	2.2	1.4
16.4	13.6	10.9	Notes Payable	16.2	10.7	5.2
12.8	11.6	10.3	Accounts Payable, Trade	14.2	12.6	10.9
5.9	5.9	5.9	Other Payables & Accruals	4.3	5.4	6.6
2.2	1.9	1.6	Provision for Income Taxes	1.4	2.4	3.4
40.6	36.2	31.7	CURRENT LIABILITIES	39.1	33.3	27.5
9.1	10.2	11.4	Real Estate Mortgages	8.7	7.6	6.5
7.4	7.9	8.4	Other Long-Term Debt	18.8	14.1	9.4
57.1	54.3	51.5	TOTAL LIABILITIES	66.6	55.0	43.4
42.9	45.7	48.5	EQUITY (NET WORTH)	33.4	45.0	56.6

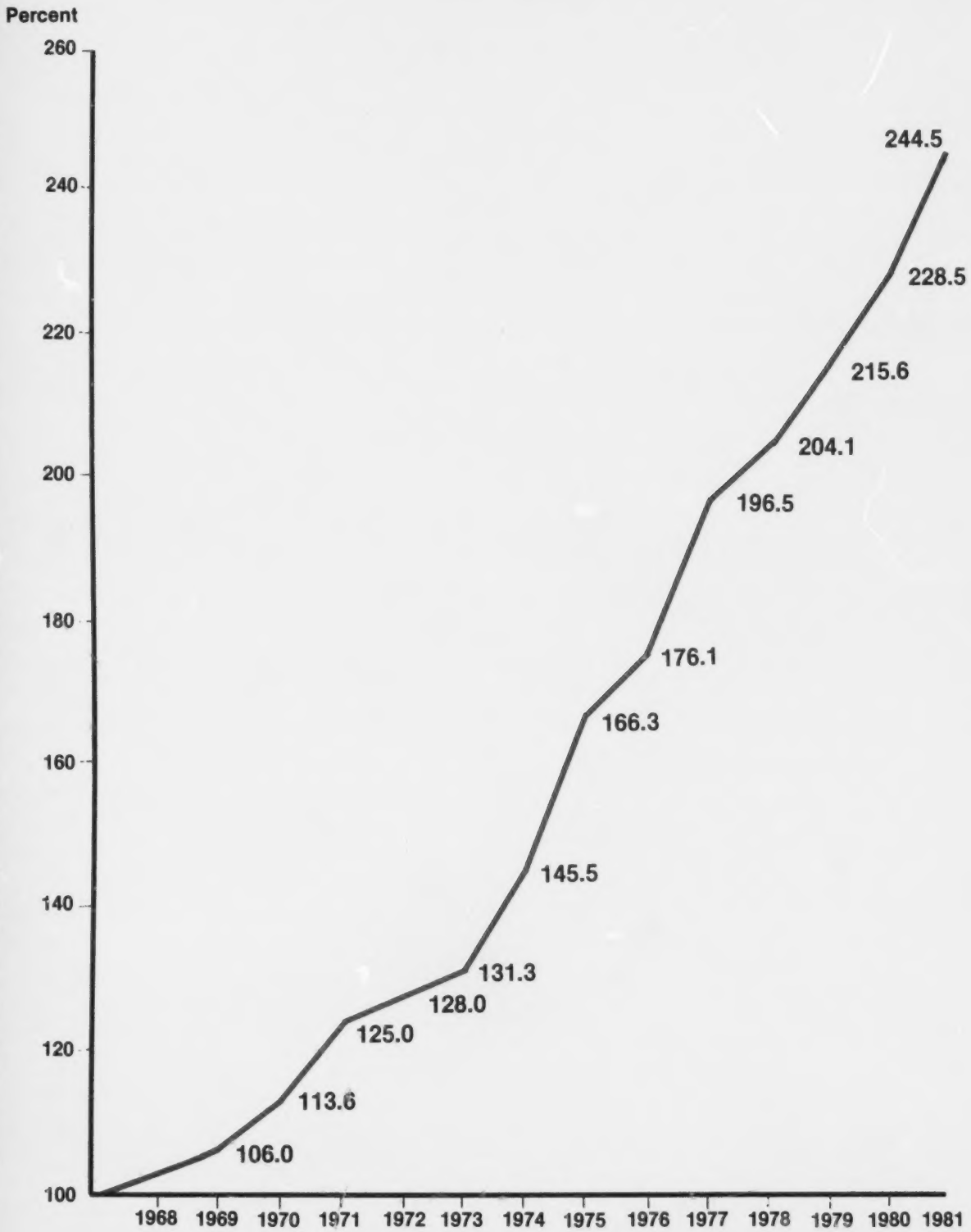
*Less Profitable: Profit Before Income Tax to Net Sales less than 3.4%.
More Profitable: Profit Before Income Tax to Net Sales equal to or more than 3.4%.
**Less Profitable: Profit Before Income Tax to Net Sales less than 4.7%.
More Profitable: Profit Before Income Tax to Net Sales equal or greater than 4.7%.

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1980

SALES LESS THAN $5 MILLION			Operating Statements	SALES $5 MILLION OR MORE		
Less Profitable*	Median	More Profitable*		Less Profitable**	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	100.0
0.6	0.6	0.6	Freight Out & Warehousing	1.5	1.3	1.0
2.0	2.0	1.8	Direct Packaging & Shipping Supplies	2.8	2.2	1.7
38.5	37.6	35.7	Direct Materials	46.6	45.1	43.4
16.3	15.3	14.3	Direct Labor	10.8	11.2	11.6
8.5	8.9	9.1	Indirect Labor	9.2	7.9	6.6
3.1	2.9	2.6	Utilities	2.7	2.6	2.4
5.4	5.1	4.8	Other Variable Mfg. Expense	5.2	5.0	4.8
3.2	2.9	2.6	Depreciation Expense	3.2	2.8	2.5
1.5	1.4	1.1	Lease Expense	0.7	0.8	0.9
1.8	1.9	1.9	Other Fixed Mfg. Expense	1.4	1.5	1.5
1.0	0.6	(0.1)	Net on Tool Transactions	(0.3)	0.2	0.6
1.7	1.5	1.3	Sales Commissions	1.2	1.6	2.1
2.6	2.8	2.9	Other Sales Expense	3.2	3.2	3.2
9.3	8.8	7.9	Administrative Expense	6.9	6.6	6.3
6.0	7.7	13.5	Operating Earnings	4.9	8.1	11.4
N.A.	1.2	2.4	Engineering Expense	1.1	1.3	1.5
2.5	1.9	1.2	Research & Development Expense	0.5	0.6	1.0
1.3	1.0	0.7	Interest	2.0	1.2	0.5
0.6	0.4	0.2	Misc. (Income) or Expense	(0.1)	0.1	0.1
0.1	3.2	9.0	Profit Before Income Taxes	1.4	4.8	8.3
(0.1)	1.1	3.4	Federal Income Tax	0.5	1.9	3.4
0.1	0.3	0.6	Other Income Taxes	0.1	0.3	0.6
0.1	1.8	5.0	PROFIT AFTER INCOME TAXES	0.8	2.6	4.3
184.7%	172.9%	161.1%	Sales as Percentage of Total Assets	184.2%	178.3%	172.4%
			Balance Sheets			
2.5	3.6	4.6	Cash & Equivalents	1.2	2.8	4.6
25.2	26.3	28.3	Accounts & Notes Receivable	23.6	25.1	26.7
10.9	11.1	11.3	Raw Material Inventory	9.5	8.7	8.0
10.3	7.0	3.5	Work in Process Inventory	3.7	3.5	3.1
4.5	5.2	5.4	Finished Goods Inventory	8.6	10.7	12.7
3.4	3.0	2.5	LIFO Reserve	5.0	5.7	6.5
0.8	0.7	0.7	Packaging & Shipping Supplies	1.2	1.1	1.0
2.9	2.4	1.8	Other Current Assets	2.4	2.1	1.8
53.7	53.3	53.1	CURRENT ASSETS	45.2	48.3	51.4
18.9	22.3	25.6	Land & Buildings, at Cost	23.7	23.2	22.6
4.7	5.5	6.2	Depreciation Reserve	6.9	6.7	6.6
58.7	53.4	49.0	Machinery & Equipment, at Cost	55.3	52.1	48.9
30.1	27.1	25.2	Depreciation Reserve	25.0	23.3	21.6
4.8	3.8	2.8	Molds, Tools, & Dies, at Cost	4.9	5.7	6.5
3.9	3.1	2.3	Depreciation Reserve	2.5	4.2	5.8
2.6	2.9	3.2	Other Long-Term Assets	5.3	4.9	4.6
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
3.0	2.8	2.6	Current Portion of Term Debt	3.0	2.3	1.5
16.3	12.7	9.2	Notes Payable	18.4	10.9	3.5
12.8	11.5	10.3	Accounts Payable, Trade	11.0	10.8	10.6
6.0	5.9	5.8	Other Payables & Accruals	5.1	5.8	6.5
0.1	1.9	3.5	Provision for Income Taxes	1.4	2.5	3.5
38.2	34.8	31.4	CURRENT LIABILITIES	38.9	32.3	25.6
14.3	13.0	11.7	Real Estate Mortgages	8.5	8.8	9.1
7.3	7.9	8.4	Other Long-Term Debt	18.7	14.3	10.0
59.8	55.7	51.5	TOTAL LIABILITIES	66.1	55.4	44.7
40.2	44.3	48.5	EQUITY (NET WORTH)	33.9	44.6	55.3

*Less Profitable: Profit Before Income Tax to Net Sales less than 3.2%.
More Profitable: Profit Before Income Tax to Net Sales equal to or more than 3.2%.
**Less Profitable: Profit Before Income Tax to Net Sales less than 4.8%.
More Profitable: Profit Before Income Tax to Net Sales equal or greater than 4.8%.

PLASTICS PROCESSING COMPANIES
TREND IN STRAIGHT-TIME HOURLY WAGES
1968-1981 (1968 = 100)



"Almost anything you can make out of anything, you can make with less energy from plastics."

Courtesy: Gulf Oil Corporation

ENERGY FEEDSTOCKS, & ADDITIVES

PLASTICS: THE ENERGY SAVER[1]

In a study prepared by Franklin Associates, Ltd. the use of plastics products and equivalent products made from non-plastics alternative materials was analyzed in terms of energy impact. The 1981 study concluded that energy consumption would increase substantially if plastics products were not available.

The results of the study are presented in terms of net energy savings. These savings are the difference between the quantity of energy consumed in the manufacture of plastics products and that of non-plastics alternative products. Energy values are given in British Thermal Units (Btu) and because of the large quantities of materials and related consumption, all energy is stated in trillion (10^{12}) Btu. For comparison, the energy content of a barrel of oil is 5.8 million Btu and of one ton of coal is 29.2 million Btu. The following summary findings are noted:

- For most end-uses, plastics products require less energy to manufacture and use than equivalent products made of alternative materials.

- In the analyses of specific resins or groups of resins, the sum of the energy required for the plastics products was always less than that required for the products made of alternative materials. In other words, when entire resins or groups of similar resins are examined for all end-uses, the energy requirements for using those resins are less than the requirements for using alternative non-plastics products.

- In 1978, if the plastics products analyzed in this study had been completely replaced by the selected non-plastics alternative products, total energy consumption would have increased by 834.2 trillion Btu.

- Although market conditions and manufacturing technologies continue to change, it is reasonable to expect the same relative energy savings from the use of plastics over non-plastics materials in future years.

- The total energy savings determined in this study are associated with the manufacture and use of 82 percent of the plastics consumed in the U.S. in 1978. It is believed that the plastics resins not included in this study would show energy savings through the use of plastics. However, the results of the study should not be extrapolated to total resin use.

- Plastics products require less energy than non-plastics products in 204 of the 264 markets studied. These 204 markets account for 90 percent of the resins analyzed. Of the 55 markets showing higher energy consumption for the plastics products, 12 showed a difference of less than 10 percent.

- To illustrate the magnitude of energy savings through plastics, 834 trillion Btu is equivalent to:

  - 75,766 million kilowatt-hours

  or

  - 28.7 million tons of coal

  or

  - 142 million barrels of oil

  or

  - 2,484 million gallons of gasoline

[1]Both the Summary and complete Franklin study are available from the Literature Department, SPI, 355 Lexington Ave., N.Y., N.Y. 10017.

Energy savings by resin, 1978

Resin	Total Energy Savings Trillion (10^{12}) Btu
High density polyethylene	159.5
Polystyrene	151.4
PVC	139.9
Polypropylene	123.0
Low density polyethylene	113.9
Polyester	86.6
ABS and SAN	49.8
Nylon	5.4
Phenolics, Urea, and Melamine	4.7
Total resin studied	834.2[1]

[1] With energy savings from wood-derived fuel omitted this figure would be 733.1 trillion Btu.

Summary of energy use by source, 1978

Comparative energy requirements associated with plastics products
Produced from twelve major plastics and
Equivalent products made of alternative materials

Trillion (10^{12}) Btu

Energy Consumption[1]

	Plastics Products[2]	Non-Plastics Alternatives	Energy Savings With Plastics (Net Difference)
Hydrocarbons	970.5	1,124.3	153.8[3]
Coal	153.7	700.7	547.0
Hydropower	13.2	30.3	17.1
Nuclear	30.0	45.2	15.2
Wood	13.9	115.0	101.1
Total	1,181.3	2,015.5	834.2 [4,5]

[1] Energy consumption represents the total energy required to manufacture the products produced from the resin included in the analysis and the non-plastics alternatives to those products.

[2] No realistic plastics alternatives were identified for 10.5 percent of the resin included in the comparative energy analysis. The energy required to produce these products is not included here.

[3] Includes an estimated savings of 186.4 trillion Btu for natural gas and an increased consumption of 32.6 trillion Btu for petroleum.

[4] Approximately 5.1 percent of the total estimated savings are calculated using service life analyses for 11 specific markets. These analyses account for the energy used in the service life of the products in addition to the energy of manufacture.

[5] With wood-derived fuel omitted the net difference would be 733.1 trillion Btu.

PLASTICS DERIVED FROM MAJOR FEEDSTOCKS*

(in millions of pounds)

Feedstock	Total Production		Plastics Derivatives		Plastics % of Total	
	1981	1980	1981	1980	1981	1980
Ethylene	28,865	27,760	17,820	16,955	62	61
Propylene	14,015	12,260	6,140	5,455	44	44
Benzene	9,870	11,420	6,525	6,125	66	54

*These data should not be construed to represent the entire feedstock needs of the U.S. plastics industry. They are based on 1980 and 1981 plastics production only and do not include feedstock needs for monomers, additives, and other chemicals not used in domestic production.

PLASTICS CONSUMPTION OF FEEDSTOCKS—1981

(millions of pounds)

ETHYLENE	Styrene Butadiene Latex	160	0.9%
	Styrene Acrylonitrile	25	0.1
	Acrylonitrile Butadiene Styrene	165	0.9
	Polyvinyl acetate	255	1.4
	Polyethylene	13,000	73.0
	Polystyrene	1,215	6.8
	Other Styrenes	45	0.3
	Polyvinyl chloride	2,955	16.6
		17,820	100.0%
PROPYLENE	Epoxy	135	2.2%
	Phenolic	1,100	17.9
	Polypropylene	4,350	70.8
	Polyester	220	3.6
	Styrene Acrylonitrile	45	0.8
	Acrylonitrile Butadiene Styrene	290	4.7
		6,140	100.0%
BENZENE	Acrylonitrile Butadiene Styrene	450	6.9%
	Styrene Acrylonitrile	70	1.2
	Styrene Butadiene Latex	375	5.7
	Polystyrene	3,300	50.6
	Other Styrene	125	1.9
	Epoxy	225	3.4
	Polyester	225	3.4
	Nylon	440	6.7
	Phenolic	1,315	20.2
		6,525	100.0%

SELECTED PLASTICS PRECURSORS

Precursor	Total Production		Plastics Derivatives		Plastics % of Total	
	1981	1980	1981	1980	1981	1980
Acrylonitrile	2,005	1,830	220	225	11	12
Bisphenol A	510	525	460	430	90	82
Butadiene	3,045	2,935	475	445	16	15
Cyclohexane	1,750	1,970	355	315	20	16
Formaldehyde	5,855	5,690	4,200	4,335	72	76
Maleic Anhydride	305	300	165	155	54	52
Phenol	2,550	2,460	1,915	1,800	75	73
Phthalic Anhydride	810	855	435	485	54	57
Styrene	6,610	6,900	5,115	4,985	77	72
Vinyl Acetate	1,935	1,920	1,935	1,920	100	100
Vinyl Chloride	6,720	6,470	6,720	6,470	100	100

Source: U.S. International Trade Commission, SRI International, Society of the Plastics Industry estimates

ADDITIVES FOR PLASTICS

ADDITIVE LUBRICANTS

These materials are added to plastics to assist flow in calendering, molding and extrusion by lubricating the metal surfaces in contact with the plastic. They also assist in knitting and wetting of the resin in mixing and milling operations. To be effective, lubricants must be compatible with the resins in which they are used, must not adversely affect the properties of end-products, and must be easily combined.

Examples: stearic acid, waxes, fatty acid esters, fatty acid amines.

ANTIOXIDANTS

They inhibit the oxidation of materials exposed to air or oxygen at normal or elevated temperatures. They are used in plastics which are subject to oxidative degradation, such as polyolefins, ABS, polystyrene, acetal and polyphenylene oxide.

Examples: alkylated phenols, amines, organic phosphites and phosphates, esters.

ANTISTATS

Chemicals which impart a slight to moderate degree of electrical conductivity to plastics compounds, thus preventing the accumulation of electrostatic charges on finished articles. They may be incorporated in the materials before molding, or applied to their surfaces after molding. They function either by being inherently conductive or by absorbing moisture from the air.

Examples: quaternary ammonium compounds, anionics, amines.

BLOWING AGENTS [FOAMING AGENTS]

Substances which alone or in combination with other substances are capable of producing a cellular structure in a plastic or rubber mass. Thus, the term includes compressed gases which expand when pressure is released, soluble solids that leave pores when leached out, liquids that develop cells when they change to gases, and chemical agents that decompose or react under the influence of heat to form a gas.

Examples: azodicarbonamide, modified azos, OBSH, HTBA.

COLORANTS

Dyes or pigments which impart color to plastics. The dyes are synthetic or natural compounds of submicroscopic or molecular size, soluble in most common solvents, yielding perfectly transparent colors. The pigments are organic and inorganic substances with larger particle sizes and usually insoluble in the common solvents. Colorants are added to plastics by dry coloring (tumbling the colorant with the base or compounded resin); by extrusion coloring (extruding a dry colored mixture and chopping it into pellets to be reprocessed); by masterbatching; or by stirring colorants or dispersions thereof into liquid plastisols or resin systems.

Examples: titanium dioxide, iron oxides, anthraquinones, carbon black.

FLAME RETARDANTS

Materials that reduce the tendency of plastic articles to burn. They are usually incorporated as additives during compounding, but sometimes are applied to surfaces of finished articles.

Examples: antimony trioxide, chlorinated paraffins, bromophenols.

HEAT STABILIZERS

Agents used in compounding some plastics to assist in maintaining the physical and chemical properties of the compounded materials at suitable values throughout the processing and service life of the material and/or the parts made therefrom. They protect plastics from the effects of heat such as changes in color, decrease in mechanical and electrical properties, and undesirable surface conditions.

Examples: lead, barium-cadmium, tin, calcium-zinc.

ORGANIC PEROXIDES

Thermally decomposable compounds which can initiate polymerization reactions and effect cross-linking upon decomposition. The rate of decomposition can be controlled by means of promoters or accelerators added to the system to increase the decomposition rate; or by inhibitors when it is desired to retard the decomposition.

Examples: MEK peroxide, benzoyl peroxide, alkyl peroxide, peresters.

PLASTICIZERS

Materials incorporated in a plastic or elastomer to increase its flexibility, workability or distensibility. Most plasticizers are nonvolatile organic liquids or low-melting point solids, which function by reducing the normal intermolecular forces in a resin thus permitting the macromolecules to slide over one another more freely.

Examples: adipates, azelates, trimellitates, DOP/DIOP/DIDP.

ULTRAVIOLET STABILIZERS (UV LIGHT ABSORBERS)

Chemical agents which absorb or screen out radiation beyond the violet end of the spectrum of visible radiations. Such radiation has sufficient energy to initiate reactions leading to the degradation of many plastics. These agents are often combined with other additives, e.g. heat stabilizers and antioxidants, with which they act in synergistic fashion.

Examples: benzophenones, benzotriazole, salicylates.

Source: Whittington's Dictionary of Plastics

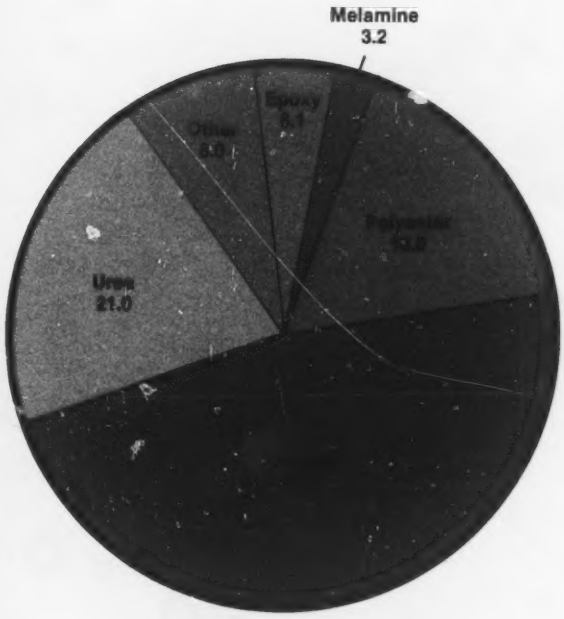
COMSUMPTION OF ADDITIVES
(millions of pounds)

Type	1977	1978	1979	1980	1981
Additive Lubricants	73	78	104	77r	91
Antioxidants	34	35	36	32	34
Antistats	4	5	5	5	6
Blowing Agents	14	15	16	10r	11
Colorants	304	320	342	307r	331
Flame Retardants	396	453	451	475	510
Heat Stabilizers	92	88	92	83	86
Organic Peroxides	29	32	39	34r	37
Plasticizers	1,782	1,615	1,654	1,485	1,505
Ultraviolet Stabilizers	4	4	5	5	5

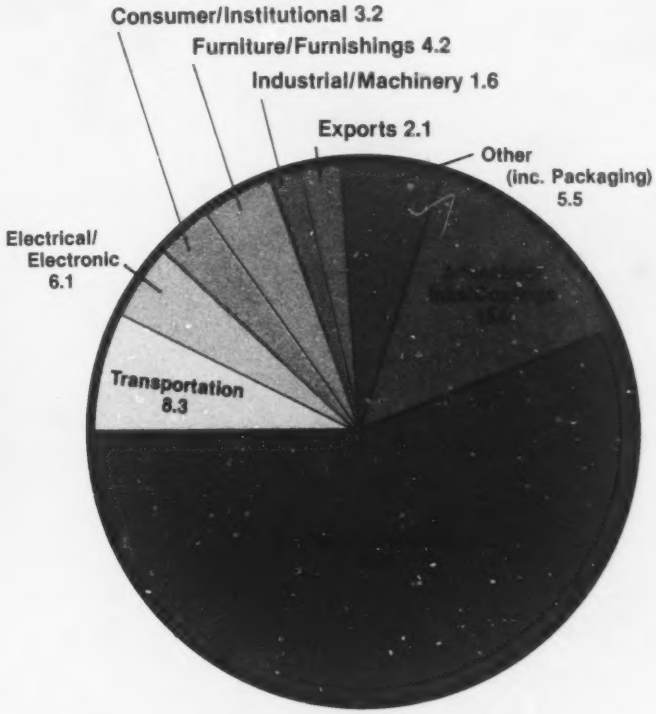
Source: Modern Plastics Magazine
r = revised from 1981 edition

THERMOSETTING RESINS

Plastics which in their final state as finished articles are substantially infusible and insoluble. They are often liquids at some state of their manufacture or processing, which are cured by heat, catalysts or other chemical means. After being fully cured, thermosets cannot be resoftened by heat.



1981 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MATERIAL



1981 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MAJOR MARKET

EPOXY

Manufacturers*

Celanese Plastics & Specialties Co.
Ciba-Geigy Corp.
Dow Chemical U.S.A.
Morton Industries
Reichhold Chemicals
Shell Chemical Co.
Union Carbide Corp.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1977	261	278
1978	299	316
1979	361	332
1980	315	319
1981	336	332
Compound Growth Rate		
1976-1981	6.6%	5.8%

Percent of Total U.S. Sales & Captive Use	
1977	0.89
1978	0.90
1979	0.86
1980	0.91
1981	0.90

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

EPOXY
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Bonding & adhesives	19	18	17	18	18
Flooring, paving and aggregates	15	17	20	19	20
Protective coatings	126	142	146	137	137
Fiber reinforced laminates & composites	44	54	60	63	66
Tooling, casting, and molding resins	23	31	31	26	29
All other uses	22	23	22	20	21
Total	249	285	296	283	291

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1978	1979	1980	1981
Transportation	*	*	*	*
Packaging	*	*	*	*
Building/Construction	34	28	48	49
Electrical/Electronic	50	66	55	58
Furniture/Furnishings	—	—	—	—
Consumer & Institutional	—	*	—	*
Industrial/Machinery	*	*	—	*
Adhesives, Inks & Coatings	153	159	150	151
All Other	48	43	30	33
Exports	31	36	36	41
Total	316	332	319	332

*Included in All Other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

PHENOLIC

Manufacturers*

Acme Resins Co.
Ametek, Haveg Div.
Ashland Chemical Co.
Bendix Corp.
Borden Chemical Co., Inc.
Cargill, Inc.
Chembond Corp.
Formica Corp.
General Electric Co.
Georgia-Pacific Corp.
Gulf Oil Chemicals Co.
Hooker Chemicals & Plastics Corp.
Inland Steel Container Co.
Inmont Corp.
Ironsides Resins, Inc.
Kesco Co.
Koppers Co.
Masonite Corp.
Monsanto Co.
Owens-Corning Fiberglas Corp.
Pioneer Plastics Corp.
Plaslok Corp.
Plastics Engineering Co.
Polymer Applications Inc.
Polyrez Co., Inc.
Raybestos-Manhattan Corp.
Reichhold Chemicals, Inc.
Rogers Corp.
Union Carbide Corp.
Uniroyal Chemical Div. Uniroyal, Inc.
Valite Div. Valentine Sugars, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use**
(millions of pounds)

Year	Production	Sales & Captive Use
1977	1,458	1,400
1978	1,827	1,788
1979	1,781	1,732
1980	1,499	1,517
1981	2,333	2,375
Compound Growth Rate		
1976-1981	n.c.	n.c.

	Percent of Total U.S. Sales & Captive Use
1977	4.50
1978	5.10
1979	4.47
1980	4.31
1981	6.43

**Gross weight basis of reporting begun in 1981.
n.c. = not comparable
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PHENOLIC
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981**
Molding Compounds	328	334	310	246	249
Bonding & adhesive resins for:					
Laminating	92	114	109	97	134
Coated & bonded abrasives	37	40	40	34	37
Friction materials	36	40	39	35	29
Insulation materials	236	279	287	271	362
Foundry & shell molding	79	111	113	80	82
Plywood	326	535	511	445	1,110
Fibrous & granulated wood	76	123	119	88	201
Resins sold to Rubber Industry	22	25	23	28	24
All other	45	59	57	74	59
Protective coatings	21	23	21	24	26
All other uses	84	79	73	72	42
Total	1,382	1,762	1,702	1,494	2,355

**Gross weight basis of reporting begun in 1981.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981**
Transportation	182	199	171	135	167
Packaging	18	11	11	10	*
Building/Construction	693	813	940	858	1,672
Electrical/Electronic	214	184	213	181	209
Furniture/Furnishings	22	18	7	11	25
Consumer & Institutional	*	48	40	33	*
Industrial/Machinery	*	24	21	21	27
Adhesives, Inks & Coatings	130	141	222	186	166
All Other	123	80	77	59	89
Exports	18	25	30	23	20
Total	1,400	1,543	1,732	1,517	2,375

**Gross weight basis of reporting begun in 1981
*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UNSATURATED POLYESTER

Manufacturers*

Advance Coatings Corp.
Alpha Chemical Corp.
Ashland Chemical Co.
Cargill, Inc.
Cook Paint & Varnish Co.
Dow Chemical U.S.A.
Freeman Chemical Corp.
Glidden Coatings & Resin Div. SCM Corp.
ICI Americas, Inc.
Inmont Corp.
Interplastics Corp.
Koppers Co.
Owens-Corning Fiberglas Corp.
Pioneer Plastics Corp.
PPG Industries, Inc.
Reichhold Chemicals, Inc.
Shell Chemical Co.
Sherwin Williams Co., The
USS Chemicals Co.
Vistron Corp.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1977	1,061	1,045
1978	1,209	1,199
1979	1,147	1,152
1980	947	949
1981	997	977
Compound Growth Rate 1976-1981	−0.9%	0.4%

Percent of Total U.S. Sales & Captive Use	
1977	3.36
1978	3.42
1979	2.98
1980	2.70
1981	2.64

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UNSATURATED POLYESTER
MAJOR DOMESTIC MARKETS
(in millions of pounds)

	1977	1978	1979	1980	1981
Domestic Reinforced Plastics, Total	824	952	906	739	764
Marine and marine accessories	204	249	227	171	178
Transportation	115	119	105	80	79
Auto, trucks, buses, etc.	98	95	86	63	60
Other transportation	17	24	19	17	19
Construction	306	338	325	287	305
General construction	124	135	122	114	128
Bathroom components & fixtures, general purpose tanks & pipes	101	118	106	79	75
Corrosion resistant tanks, pipes, etc.	81	85	97	94	102
Electrical generation, transmission and distribution	34	30	26	23	22
Consumer goods	67	83	85	66	65
Major appliances and parts	14	15	11	7	12
Recreational goods, toys, etc.	15	19	23	19	22
Other consumer goods	37	49	51	40	31
Gel coats	36	46	37	26	26
Other reinforced	62	87	101	86	89
Domestic Non-Reinforced Plastics, Total	208	232	231	214	202
Castings	130	159	160	144	123
Furniture	10	10	7	6	7
Cultured marble & onyx	56	60	67	63	61
Other	64	89	86	75	55
Autobody putty	49	50	45	41	45
Surface and protective coatings	6	6	5	5	5
Bonding and adhesives	6	4	5	5	3
Other non-reinforced	17	13	16	19	26

Source: Quarterly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	398	383	362	261	259
Packaging	*	—	—	*	*
Building/Construction	340	423	434	384	401
Electrical/Electronic	27	37	39	25	33
Furniture/Furnishings	*	24	26	26	24
Consumer & Institutional	71	138	138	100	94
Industrial/Machinery	73	80	88	*	*
Adhesives, Inks & Coatings	12	22	15	10	9
All Other	111	77	36	132	146
Exports	13	15	14	11	11
Total	1,045	1,199	1,152	949	977

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UREA

Manufacturers*

American Cyanamid Co.
Borden Chemical Co., The
Cargill, Inc.
Celanese Plastics & Specialties Co.
Chembond Corp.
Conchemco, Inc.
Cook Paint & Varnish Co.
Dan River Inc.
Georgia-Pacific Corp.
Glidden Coatings & Resins Div. SCM
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Gulf Oil Chemicals Co.
Kesco Co.
Maplechem Inc.
Monsanto Co.
Pioneer Plastics Corp.
Plaskon Div. Hillside Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Valchem Div. United Merchants

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	963	951
1978	1,122	1,103
1979	1,367	1,355
1980	1,165	1,147
1981	1,165	1,139
Compound Growth Rate 1976-1981	7.3%	7.1%

Percent of Total U.S. Sales & Captive Use

1977	3.06
1978	3.15
1979	3.50
1980	3.26
1981	3.08

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MELAMINE

Manufacturers*

American Cyanamid Co.
American Hoechst Corp.
Borden Chemical Co., The
Cargill, Inc.
Celanese Plastics & Specialties Co.
Chembond Corp.
Conchemco, Inc.
Cook Paint & Varnish Co.
Dan River Inc.
Formica Corp.
Georgia-Pacific Corp.
Glidden Coatings & Resins Div. SCM
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Maplechem Inc.
Monsanto Co.
Owens-Corning Fiberglas Corp.
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Rohm and Haas Co.
Valchem Div. United Merchants

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	200	203
1978	202	196
1979	200	192
1980	167	166
1981	179	175
Compound Growth Rate 1976-1981	−0.8%	−0.8%

Percent of Total U.S. Sales & Captive Use

1977	0.65
1978	0.56
1979	0.50
1980	0.47
1981	0.47

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UREA AND MELAMINE

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Paper treating & coating resins	62	71	76	70	73
Molding Compounds	105	101	104	75	75
Bonding & adhesive resins for:					
Laminating	33	30	29	27	32
Plywood	78	90	86	74	74
Fibrous & granulated wood	693	813	1,029	896	884
Protective coatings	85	93	88	66	69
All other uses	69	77	111	87	83
Total	1,125	1,275	1,523	1,295	1,290

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	*	25	24	*	*
Packaging	24	25	34	*	*
Building/Construction	583	662	915	833	820
Electrical/Electronic	*	49	52	*	*
Furniture/Furnishings	*	274	206	168	181
Consumer & Institutional	45	45	35	51	48
Industrial/Machinery	*	—	—	*	*
Adhesives, Inks & Coatings	132	125	134	99	90
All Other	341	70	123	144	151
Exports	29	24	24	18	24
Total	1,154	1,299	1,547	1,313	1,314

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

MISCELLANEOUS THERMOSETS
(in millions of pounds)

	Production				
Resin	**1976**	**1977**	**1978**	**1979**	**1980**
Alkyds	705	753	754	755	703
Furfuryl-type	8	n.a.	17	31	25
Silicones	15	18	16	20	12
Dicyandiamide	2	2	2	2	2
Other[1]	26	91	60	70	169

	Sales				
Resin	**1976**	**1977**	**1978**	**1979**	**1980**
Alkyds	471	434	415	408	392
Furfuryl-type	8	n.a.	16	30	25
Silicones	13	11	11	11	8
Dicyandiamide	2	2	2	2	2
Other[1]	24	70	49	61	121

n.a. = not available
[1]Includes acetone-formaldehyde, glyoxal-formaldehyde, polybutadiene, and other thermosets.
Source: *Synthetic Organic Chemicals,* U.S. International Trade Commission.

POLYURETHANE FOAMS

TECHNICAL BACKGROUND

Urethane foams are cellular plastics generally formulated by the reactions of two liquids—a polyol and a polyisocyanate—in the presence of a blowing agent, a catalyst, a surfactant, and perhaps other special additive chemicals such as fire retarding agents. By altering the choice of polyol, the type of isocyanate and other ingredients, substantially different polyurethane foams can be made. Depending on their physical characteristics, these foams are classified as flexible, semi-flexible, or rigid with densities ranging from one to more than 60 pounds per cubic foot. The distinction between rigid and flexible urethane foams is fundamental in that their use and disposal characteristics are very different, as are the problems associated with each. Polyisocyanurate foams are considered to fall into the class of rigid urethane foams, since their physical and mechanical properties are similar but they do have improved thermal and combustibility properties.

Production of *rigid* urethane foam involves metering the resin mix (polyol, surfactant, blowing agent and catalyst) and isocyanate through a high speed mixer. The blended components may be used for bun stock, molding, frothing, spraying or continuous laminating.

Most *flexible* urethane foam is produced in a continuous bun up to 8 feet wide, 45 inches high and cut into any desired length. After curing, the buns are sold to fabricators or cut into various shapes and sizes depending on end use (usually cushioning for furniture, mattresses and bed pillows). Flexible urethane foams can be molded to produce complex shapes without extensive fabrication. Final decision concerning the type and quality of ingredients, including special fire retardants and foam properties to be formulated, are made by the individual foamers, molders and applicators in response to demands of their consumer markets.

Because of the extraordinary variety of formulations possible, urethane foams, both rigid and flexible, can be produced to meet a broad spectrum of properties covering density, load bearing, resiliency, compressive strength, closed cell content, water vapor permeability, water absorption, shear and impact strength, elasticity, heat resistance, thermal conductivity and various combustibility properties. Proper care must be exercised to insure that the formulation is not only functionally and economically efficient, but also safe for the intended use.

USE

Urethanes are essentially a new technology material which, while being similar chemically to many other plastics, have unique use characteristics. They are currently the most efficient insulating material on the market and the most widely used cushioning materials; they perform exceptionally well in buoyancy, as a reinforcement material, as an impact absorber, as a sound absorber, as a protective coating, as an adhesive, as a sealant and as a decorative material. Due to their wealth of functional properties and their high degree of cost competitiveness relative to substitutes, urethanes have experienced broad consumer acceptance and market growth.

USE OF FLEXIBLE FOAM

Flexible foam normally ranges in density from 1 to 3 pounds per cubic foot. It has high resiliency and its shape can be easily altered. It can be cut, molded, laminated or bonded to meet a broad spectrum of product and application requirements.

POLYURETHANE FOAM—DOMESTIC SALES & CAPTIVE USE
(in millions of pounds)

	1977	1978	1979	1980	1981	Compound Growth Rate 1976-1981
Flexible and Semi-Flexible Foam						
Bedding (excluding sofa beds)	149	161	152	139	143	+1.0%
Furniture	444	484	461	432	437	+2.6
Packaging	28	33	31	23	35	+5.3
Rug and Underlay	146	132	143	161	165	+7.9
Textile Laminates	28	34	42	38	36	+5.9
Transportation	383	390	352	242	227	−8.3
Miscellaneous	62	71	44	58	40	−8.4
Scrap	152	136	150	80	101	−3.7
Total Flexible and Semi-Flexible Foam	1,392	1,441	1,375	1,173	1,184	−0.6%
Rigid Foam						
Appliances	81	79	84	69	76	+0.5%
Building Construction	236	283	322	315	328	+12.9
Furniture	32	33	25	22	16	−11.8
Marine Flotation	16	18	17	15	15	+2.9
Packaging	21	24	31	34	42	+21.0
Transportation	58	58	49	46	41	−5.7
Miscellaneous	21	25	27	38	42	+23.0
Total Rigid Foam	465	520	555	539	560	+7.9%
Grand Total Foam	1,857	1,961	1,930	1,712	1,744	+1.7%

Source: Polyurethane Foam End-use Survey,
SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

In Furniture—For furniture use, flexible foam is generally produced in slab form and then cut into cushioning for sofas and chairs. The cushioning market is now dominated by flexible urethane foam. In addition to ease of production, its benefits include relatively uncomplicated fabrication, good load bearing characteristics, and comparatively low cost. High resilience foam molding is a growing segment for furniture consumption due to its ability to produce custom contoured pieces in volume. Cold-curing reduces the need for special oven cures and time-consuming cooling cycles. The finished product also has better seating characteristics than hot molded foam.

Integral skin (self-skinning) flexible foam has properties which compare favorably with its conventional alternative (molded foam covered with vinyl sheet). Due to its excellent flow characteristics, it can be poured into very complex closed molds for a variety of shapes. It can be produced in soft grades for seating or in firm grades for automotive soft-trim parts.

In Transportation—The second largest market for flexible urethane foam is in the transportation industry. In 1970, approximately 19 pounds of foam were used in the average passenger car. By 1979 this had increased to approximately 45 pounds per car. Most of this flexible foam is used in connection with providing comfort and safety. Since September 1, 1972, foams used in this application have been subject to Federal Motor Vehical Safety Standard No. 302—Flammability of Interior Materials—Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses.

In the safety area, semi-flexible foam with its low resiliency and high energy absorption properties is used for dash boards, head rests and arm rests. High density or micro cellular foam is also used in car bumpers for its impact resistance. Reticulated polyester urethane foam is being used as a safety measure in gasoline tanks of racing cars. Some manufacturers are experimenting with foam in door panels and roofs to improve impact resistance, to lessen noise and vibration, to insulate in winter and summer, and generally to increase passenger safety. Urethane consumption will be stimulated further by new Federal safety regulations requiring more impact-absorbing material in all new cars.

In Bedding—Relative to its two competitors, latex rubber and inner springs, urethane foam bedding exhibits comparable comfort and lower cost. It weighs 30 per cent less than inner spring mattresses and as much as 50 per cent lower than foamed rubber. It is easy to turn, can be made to a controlled degree of firmness, has excellent chemical resistance, is long-lasting, non-allergenic and sterilizable. The combustibility of the mattress composite is regulated by the Consumer Product Safety Commission Standard FF 4-72—Flammability of Mattresses.

In Apparel/Textiles—Flexible urethane foam can be bonded or laminated to almost any fabric. In the apparel industry, urethane foam is used to bond face fabrics to linings. This provides cost savings by eliminating the need to cut and sew in separate linings. Foam-bonded and foam-laminated fabrics have been accepted by the large home sewing market because they are very easy to work with, can provide warmth without weight, are comfortable and wrinkle resistant, and they retain their shape. This technique is also applied to shoes, drapes, slip covers, sleeping bags, etc.

In Carpets—Urethane foam is used both as separate carpet pads and on foam-backed carpets. Growth opportunities in this market are good: urethane foam is lighter than its competitors while being less expensive and odor free; it has good tensile strength, is both non-allergenic and resistant to deterioration from moisture, insects, etc., and has superior aging characteristics. Foam-backed carpet composites fall under the jurisdiction of Consumer Product Safety Standards FF 1-70 and FF 2-70 for the surface combustibility of carpets and rugs. Other agencies also have regulations of combustibility covering separate carpet pads.

USE OF RIGID URETHANE FOAM

Rigid foam, like flexible, has a wide range of formulations, densities and uses. For most applications, its density ranges from 1 to 3 pounds per cubic foot, but furniture applications may utilize foams with densities up to 45 pcf.

Rigid foam has good dimensional stability both at high and low temperatures, extremely good insulating values, high compressive strength, relatively low water absorption, excellent buoyancy, and can be molded into rather intricate shapes. It is easy to produce, extremely versatile, and relatively inexpensive. It can be produced by spray, pour-in-place, molding, continuous slab or laminating techniques.

In Construction—Rigid foam insulation is durable and competitive in cost, and has extremely low thermal conductivity and water absorption qualities. Relative to its competitors, it saves from 10% to 30% in comparable thicknesses on the cost of heating and cooling those structures which it insulates as well as proportionately decreasing heating and cooling equipment size. This fact becomes increasingly meaningful with the growing use of more expensive electric heat and the growing critical need to conserve the nation's dwindling energy resources.

Since the development of foam systems acceptable to building code officials, their use has been more generally accepted. Foam has been used successfully as sprayed-on insulation for homes and commercial buildings, with proper protection for fire safety, and as insulation for storage tanks. The Urethane Safety Group of SPI recommends covering rigid urethane foam insulation with a suitable flame barrier as soon as possible after installation.

In Refrigeration—Expanding use of frozen foods has contributed to the increased use of rigid foam in the refrigeration industry. Rigid urethane, used primarily in refrigerators and freezers, has the largest share of the appliance insulation market due to its low thermal conductivity, flexibility in application (foamed-in-place, spray or slab) and the strength it provides to the structure when the foam is bonded to the inside and outside panels. Also, relative to its competitors, rigid foam's superior insulating qualities permit thinner wall construction thus allowing in-house appliances substantially more interior refrigerator or freezer space for the same outside dimensions.

Rigid foam is also considered to be the best available insulating material for use in equipment for transporting frozen food. Specifically, in refrigerated rail or highway vehicles, half as much rigid foam is needed to produce the same insulation efficiency as is produced by glass fibers.

In Furniture/Interior Decoration—The potential for rigid foam appears to be unlimited because it can be used both structurally and decoratively in the higher densities (4 to 40 pounds per cubic foot). It is comparable to or better than other traditional materials considering that: it has uniform reproducible quality, can be mass produced in a variety of densities and textures, and has outstanding impact resistance. It appears in many forms—tables, cabinets, chair shells, picture frames, decorative beams, wall panels, etc. Certain types of rigid foam furniture have been formulated to provide some degree of flame retardant characteristics which make them more readily acceptable among public or private institutions such as schools and hospitals. Programs are underway studying the combustibility characteristics of these types of foams.

In Transportation—Rigid foam is already used as insulation for car air conditioners, in insulating railroad cars and in trailer trucks. With its superior strength to weight properties, rigid foam can eventually be used for a broad array of automobile structural and mechanical parts, including exteriors. Experimental cars have been built which are virtually all urethane. Rigid foam will also be a key safety material due to its very efficient energy absorption characteristics.

In Marine Use—In addition to its insulation benefits, rigid foam has superior buoyancy characteristics. It has been used successfully in marine salvage operations, in life saving gear, in nuclear submarines, rafts, swimming pools, sporting goods and numerous other floating articles.

POLYURETHANE PRODUCTS

In addition to foams, urethane chemicals find their way into a broad range of other polyurethane products. While the foams represent the dominant end-use outlets for chemicals, these other polyurethane products constitute a sizeable marketplace in themselves, and hence are worthy of separate mention.

The three major subcategories within the Polyurethane Product Reporting Program (of SPI) are Castable Types, Millable Gums, and Thermoplastic Types. The Millable Gums quantities are very small, and the Thermoplastic Types are also overshadowed by the Castables.

Within the Castables subcategory, there is a further break-down among Solid Materials, Microcellular Materials, and a catchall covering Adhesives, Sealants and Coatings. These three product/market areas are roughly comparable in size at present.

The various categories of Polyurethane Products have widely differing properties, end-uses, and growth rates. The Castable/Solid materials represent a well-established product line with a wide spectrum of end-uses which encompass both industrial, mechanical and consumer goods. Growth has been modest. In contrast, the Microcellular types represent new products, still in their rapid growth phase. Primary uses to date have been in automotive applications and for shoe soles. The Adhesives, Sealants, and Coatings grouping by and large represents established applications with modest growth. Similarly, Millable Gums are sold into established markets. The final category—Thermoplastic types—present a more complicated picture. The materials have been around for more than ten years and growth of late has been disappointing. Major markets include automotive, industrial uses such as cable jacketing, and molded parts for both industrial and consumer goods. Depending upon application development work and the dymanics of competing products, Thermoplastic Urethanes have the potential for capturing significantly increased volume of business in the years ahead.

PRODUCTION OF POLYURETHANE PRODUCTS
(thousands of pounds)

	1977	1978	1979	1980	1981
Castable Types, Total	182,923	237,959	269,501	207,095	249,189
Solid	56,409	72,920	83,975	71,771	82,593
Microcellular	53,040	63,394	71,204	63,120	59,308
Adhesives, Sealants & Coatings	73,474	101,645	114,322	72,204	107,288
Millable Gum Type	1,061	1,069	1,505	2,584	2,239
Thermoplastic Type	40,837	39,273	49,761	45,793	45,678
Total Polyurethane Products*	224,821	278,301	320,767	255,472	297,106

*Industry estimate.

Source: Semi-annual Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

ISOCYANATES
(in millions of pounds)

Year	Production			Sales & Captive Use
	Total	TDI*	Other Isocyanates	Total
1977	1,011	582	429	1,047
1978	1,129	611	518	1,138
1979	1,248	681	567	1,234
1980	1,126	536	590	1,079
1981	1,147	537	610	1,163

Participating Companies—1981

Allied Corp.
BASF Wyandotte Corp.
Dow Chemical U.S.A.
E.I. duPont de Nemours & Co.
Mobay Chemical Corp.
Olin Corp.
Rubicon Chemicals, Inc.
The Upjohn Co.

POLYETHER POLYOLS
(in millions of pounds)

Year	Production	Sales & Captive Use
1977	1,304	1,281
1978	1,404	1,399
1979	1,510	1,491
1980	1,225	1,231
1981	1,264	1,266

Participating Companies—1981

BASF Wyandotte Corp.
Chemetic Systems
Choate Chemical
Dow Chemical U.S.A.
E.I. duPont de Nemours & Co.
Mobay Chemical Corp.
Olin Corp.
Owens-Corning Fiberglas Corp.
PPG Industries
Quaker Oats Co.
Reichhold Chemicals, Inc.
Texaco, Inc.
U.C.T., Inc.
Union Carbide Corp.
The Upjohn Co.
Witco Chemical Corp.

POLYESTER POLYOLS
(in millions of pounds)

Year	Production	Sales & Captive Use
1977	28	26
1978	42	41
1979	43	41
1980	42	40
1981	47	46

Participating Companies—1981

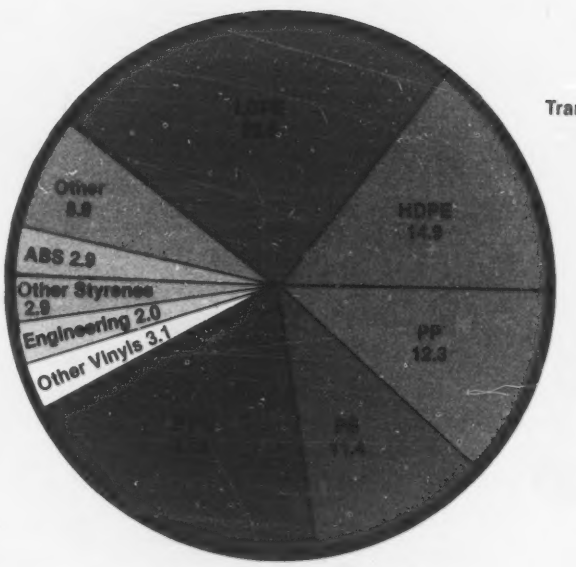
Hooker Chemical—Ruco Div.
Mobay Chemical Corp.
Union Carbide Corp.
Uniroyal Chemical Co.
Witco Chemical Corp.

*Toluene Diisocyanate (80/20 mixture).

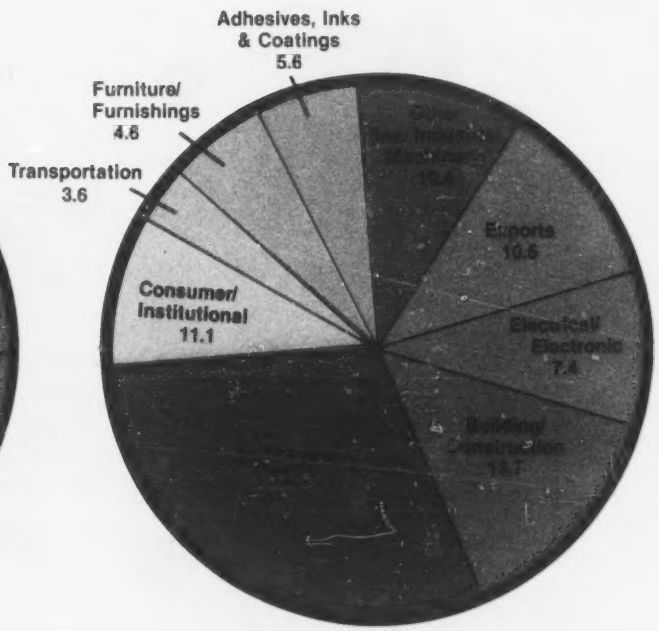
Source: Quarterly Polyols and Isocyanates Reports, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

THERMOPLASTIC RESINS

Plastics which in their final state as finished articles are capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature and physical change.



1981 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MATERIAL



1981 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MAJOR MARKET

ABS AND SAN

Manufacturers*

Borg Warner Chemicals
Dow Chemical U.S.A.
B.F. Goodrich Chemical Co.
Carl Gordon Industries
Mobay Chemical Co.
Mobil Chemical Co.
Monsanto Company
USS Chemicals

*Those companies who participated in the SPI Monthly Statistical Report in 1981.

Production and Sales & Captive Use
(millions of pounds)

Year	Production		Sales & Captive Use	
	ABS	SAN	ABS	SAN
1977	1,069	115	1,057	113
1978	1,134	120	1,118	121
1979	1,191	124	1,183	126
1980	920	111	916	103
1981	916	107	900	105
Compound Growth Rate 1976-1981	−1.5%	−1.1%	−0.5%	0.2%

Percent of Total U.S. Sales & Captive Use

	ABS	SAN
1977	3.40	0.36
1978	3.19	0.35
1979	3.06	0.33
1980	2.60	0.29
1981	2.44	0.28

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

ABS AND SAN
MAJOR DOMESTIC MARKETS
(in millions of pounds)

End-use	1978	1979	1980	1981
ABS				
Consumer & Institutional	n.a.	n.a.	n.a.	132
Pipe, Conduit & Fittings	356	302	208	180
Electrical & Electronic	n.a.	229	193	195
Transportation	n.a.	n.a.	154	161
Other	725	593	304	180
Total	1,081	1,124	859	848
SAN				
Total	104	108	90	91
Grand Total	1,185	1,232	949	939

n.a. = not available.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	291	303	317	185	177
Packaging	26	21	33	26	29
Building/Construction	333	346	341	234	194
Electrical/Electronic	246	278	257	265	209
Furniture/Furnishings	*	8	16	8	*
Consumer & Institutional	111	130	139	93	165
Industrial/Machinery	37	21	15	13	*
Adhesives, Inks & Coatings	*	—	—	—	—
All Other	85	78	114	125	165
Exports	40	54	77	69	66
Total	1,169	1,239	1,309	1,019	1,005

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

ENGINEERING THERMOPLASTIC RESINS

The following resins are generally considered to be included in the category of engineering resins: fluoropolymers; polyimides and polyamide-imides; modified polyphenylene oxide; polyphenylene sulfide; thermoplastic polyester resin; polycarbonate; polysulfone; and acetal. Other materials which may be used in similar applications such as ABS, SAN, and nylon are mentioned elsewhere in Facts & Figures. Fluoropolymers, likewise, are mentioned elsewhere but their production and sales & use data are included below.

Engineering resins are characterized by a combination of high ratings for mechanical, thermal, electrical, and chemical properties. Fillers such as glass, carbon, metallic oxides, metallic powders, calcium carbonate, and silica products, and reinforcements such as fibrous glass, asbestos, carbon, and other inorganic and organic fibers are added to improve these properties.

Typical Applications

Acetal (AC)	Sinks, faucets. electrical switches, gears, aerosol bottles, meat hooks, lawn sprinklers, ballcocks, shaver cartridges, zippers, telephone push-buttons.
Polycarbonate (PCO)	Helmets, power tool housings, battery cases, safety glass, auto lenses, 5 gal. bottles
Polyphenylene Sulfide (PPS)	Electrical connectors, coil forms, lamp housings.
Thermoplastic Polyester (TP)	Electrical bobbins, TV tuners, fuse cases, bearings, cams, auto ignition coil caps, speedometer frames, pump impellers and housings.
Polysulfone (PSO)	Electrical connectors, meter housings, coffeemakers, camera bodies, auto switch and relay bases, light-fixture sockets, fuel cell components, battery cases.
Modified Polyphenylene Oxide (PPO)	Auto dashboards, pumps, shower heads, plated auto grilles and trim, appliance housings, wiring splice devices, protective shields.
Polyimide (PI)	Radomes, printed circuit boards, turbine blades.
Polyamide-imide (PAI)	Valves, gears, pumps, high temperature magnet wire enamels.

ENGINEERING THERMOPLASTIC RESINS

Manufacturing

Known Manufacturers	AC	PCO	PPS	TP	PSO	PPO	PI	PAI	FLUORO-POLYMERS
Allied									X
American Hoechst				X					
Amoco Chemical							X	X	
Celanese Plastics & Spec.	X			X					
Dupont	X			X			X		X
Eastman Chemical				X					
GAF				X					
General Electric		X		X		X			
Goodyear				X					
ICI Americas									X
Mobay Chemical		X							
Phillips Petroleum			X						
Rohm and Haas				X					
Union Carbide					X				

(see opposite page for complete names of resins.)

Production and Sales & Captive Use
(in millions of pounds and dollars)

Year	Production	Sales & Captive Use	Sales (excl. Captive & Exports)
1977	605	576	$486
1978	648	639	579
1979	729	709	699
1980	673	645	715
1981	676	633	806

Source: SPI Committee on Resin Statistics as compiled by Ernst & Whinney

Compound Growth Rate of Sales & Captive Use	
1976-1981	n.a.
1980-1981	– 1.9%

n.a. = not available

Distribution by Major Market
(in millions of pounds)

Major Market	1977r	1978r	1979r	1980r	1981
Transportation	85	88	101	78	76
Packaging	1	3	8	1	1
Building & Construction	70	78	97	86	96
Electrical/Electronic	155	176	231	216	211
Consumer/Institutional	33	38	38	32	37
Industrial/Machinery	70	77	67	55	58
Other	34	50	21	42	34
Exports	128	129	146	106	120
Total	576	639	709	645	633

rRevised from 1981 edition

Source: Industry estimates.

FLUOROPOLYMERS

The fluoropolymers industry received its start with the discovery of polytetrafluoroethylene in 1938. Later during World War II its first use was as a gasket in packing materials in extremely corrosion-resistant applications for the Manhattan project. As the war progressed and radar became airborne, polytetrafluoroethylene was found to be the only insulation that had the required combination of electrical properties, toughness, and heat resistance to perform properly. Since this beginning other fluoropolymer resins have been made available and are in general use today. They are chlorotrifluoroethylene (CTFE), polyvinyl fluoride (PVF), polyvinylidene fluoride (PVF_2), fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), ethylene chlorotrifluoroethylene (ECTFE), and perfluoroalkoxy copolymerized with tetrafluoroethylene (PFA).

These fluoropolymer resins have an outstanding combination of properties and are capable of performance unavailable from any other group of resins. They have outstanding chemical resistance and are inert to virtually all chemicals and solvents, the most corrosive fuels or oxidizers and in the most difficult atmospheres. In addition, they do not contaminate other products with which they come in contact. They have high stable electric properties with minimum dissipation factor, low dielectric constants, high volume and surface resisitivity, high dielectric strength, and are constant over a wide range of frequencies and temperatures. The useful temperature range for these resins is from $-400°$ to $+550°$F. They ar among the most slippery solids known and provide excellent sliding surfaces for bearings and other applications. They have good physical properties which can be improved by reinforcing agents and are tough and flexible even at very low temperatures. Finally, they are unaffected by exposure to sun, freezing cold, or outdoor weathering of any kind.

As a result of this unusual combination of properties, fluoropolymers are used in virtually all areas of industry today. The most important of these are: (1) Electric—in shrinkable tubing, coaxial cable connectors, slip-on insulation, connectors, capacitors, and insulated wire; (2) Chemical—in pipe fittings, expansion joints, valves, seals, gaskets, seatings, laboratoryware, linings for valves and pumps, thread sealants, and other sealant products; and (3) Mechanical—in piston rings, valve seats, energy absorbing devices, cruise control parts, and bearing pads for the construction industry.

Fluoropolymers are also used in the aerospace and aircraft industry and more recently in medical and consumer markets. In the consumer field they are used to coat cookware, saw blades and also as components for such applications as coffee pots, urns, and toasters.

Suppliers of Granular PTFE Resins

Allied Chemical Corp.
American Hoechst Corp.
Custom Compounding
E.I. duPont de Nemours & Co.
ICI Americas
LNP Corporation
Mikro Technik
Montedison USA
Ugine Kuhlmann of America, Inc.

U.S. SALES OF FLUOROPOLYMER RESINS (GRANULAR TYPE ONLY)
(in thousands of pounds)

	1977	1978	1979	1980	1981
Virgin, First Quality	6,149	6,976	7,819	7,310	7,699
Filled Resin, including colors	3,013	3,192	3,351	2,846	3,276
Miscellaneous lubricants, release compounds, etc.[1]	2,909	2,847	3,234	3,349	3,542
Total	12,071	13,015	14,404	13,505	14,517

[1]. Includes broad specification second quality.
Source: SPI's Fluoropolymers Division.

Compound Growth Rate
1976-1981

Virgin, First Quality	4.4%
Filled resin, included colors	5.9
Miscellaneous lubricants, release compounds, etc.	8.5
Total	5.7%

HIGH DENSITY POLYETHYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1981	1982	1983
Allied Corp.	650	650	650
American Hoechst Corp.	220	220	250
Amoco Chemicals Corp.	340	340	340
ARCO/Polymers	325	325	325
Chemplex Company	300	300	300
Cities Service Co.*	175	—	—
Conoco Chemicals Co.	—	—	430
Dow Chemical U.S.A.	450	450	450
DuPont, E.I. de Nemours & Co.	425	425	425
Gulf Oil Chemicals	420	570	570
Hercules Incorporated	15	15	15
National Petrochemicals Corp.	500	500	500
Phillips Petroleum Co.	1,425	1,425	1,425
Soltex Polymers	555	555	555
Union Carbide Corp.	200	200	200
Total	6,000	5,975	6,435

*Closed down their plastics operations in 1982.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources:

Production and Sales & Captive Use
(millions of pounds)

Year	Production	Sales & Captive Use
1977	3,652	3,557
1978	4,201	4,165
1979	5,010	4,893
1980	4,405	4,394
1981	4,695	4,683
Compound Growth Rate 1976-1981	8.5%	8.4%

	Percent of Total U.S. Sales & Captive Use
1977	11.44
1978	11.88
1979	12.64
1980	12.49
1981	12.67

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

HIGH DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Film (12 mils & below)	136	189	212	201	281
Sheet (over 12 mils)	60	55	66	55	52
Injection molding	682	802	1,074	938	997
Wire & Cable	98	115	126	106	111
Extrusion Coating	45	40	30	28	33
Blow Molding	1,258	1,461	1,724	1,573	1,696
Pipe & conduit	267	344	400	369	408
Other extruded products	24	21	19	24	18
All other uses	558	647	634	573	626
Total	3,128	3,674	4,285	3,867	4,222

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	42	62	90	85	63
Packaging	1,607	1,865	2,190	2,049	2,367
Building/Construction	308	413	445	428	486
Electrical/Electronic	138	170	210	167	146
Furniture/Furnishings	13	12	14	*	*
Consumer & Institutional	378	488	496	495	482
Industrial/Machinery	70	52	106	*	102
Adhesives, Inks & Coatings	—	—	—	—	*
All Other	575	612	733	644	576
Exports	426	491	609	526	461
Total	3,557	4,165	4,893	4,394	4,683

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

LATEX MATERIALS

Latex materials (sometimes referred to as emulsion polymers) are dispersions of the plastic polymer particles in water. Developed in the laboratory in the early 1930's, the first successful product was a synthetic rubber latex, commercialized during World War II to supplement the short supply of natural rubber latex.

A great variety and profusion of emulsions are now in commercial production. The most important of the plastic latexes are copolymers of styrene and butadiene, homopolymers and copolymers of vinyl acetate, acrylates, and vinyl chloride, as well as emulsions of polyvinyl chloride, polyvinylidene chloride, and other specialties. Other co-monomers used include fumarate, maleate, and ethylene.

The non-plastic synthetic rubber latices, excluded from SPI statistics, are elastomers categorized as Styrene/Butadiene (high butadiene), Polybutadiene, Acrylonitrile/Butadiene, Chloroprene, and Butyl. There is a significant amount of inter-product competition, particularly among the plastic types, and further there is competition with the synthetic and natural rubber latices which historically have been used.

The major end-uses for these plastic latex materials lie in four areas: (1) Adhesives—primarily in the packaging, construction, and wood products areas; (2) Coatings—primarily as a vehicle in water-based paints; (3) Paper—primarily as a clay coatings binder, but also used for saturating; and (4) Textiles—primarily as fabric finishes, sizes, back coats, and in fabric lamination and non-woven fiber bonding.

The emulsions and compounds are generally sold or used in relatively small batches (drums, tank trucks, and tank cars), and in many applications the emulsions are tailor-made to the end-use. There are thousands of end-users, some of whom polymerize for themselves, some of whom buy compounded material.

Each product sold has some unique characteristic desired in the end-use. For example, some adhesive resins should impart water resistance, fabric resins should be hard or soft depending on the type desired, and coatings resins should have good tint retention properties.

As a class these plastic emulsions have gained wide acceptance in the above mentioned end-uses for one or more of the following reasons:

—Water base (will meet the requirements of air pollution controls and regulations)
—Ease of clean-up
—Good adhesion to various substrates
—High pigment binding capacity
—Abrasion resistance and flexibility
—Uniform quality as compared with natural binders
—Good supply picture as compared with many of the natural binders
—Relative low cost versus binding efficiency
—Compatibility with existing technology and processes

Significant Producers*

Air Products & Chemicals	B.F. Goodrich Chemical	Polysar Corp.
American Synthetic Rubber	Goodyear Tire & Rubber	Reichhold Chemicals
Borden Chemical	W.R. Grace	Rohm and Haas
Dow Chemical	Hooker Chemical	Union Carbide Corp.
DuPont	Monsanto Company	Union Chemical
H.B. Fuller Company	Morton Chemical	U.S. Industrial Chemicals
General Tire & Rubber	National Starch	USS Chemicals

*Those producers in the SPI statistical report.

Production by product type and end-use is as follows:

Product Type	Approximate % of Total
Polyvinyl acetate homopolymers and copolymers	49
Styrene/butadiene polymers	44
All other	7
	100

End-Use	Approximate % of Total
Export	3
Domestic	97
Emulsion paint	16
Adhesives	21
Paper treating and coating	26
Textile and non-woven	7
Other	27
	100

STYRENE BUTADIENE & OTHER STYRENE BASED LATEXES

Styrene Butadiene Latexes are an outgrowth of the World War II development of GRS Latex used in the manufacture of synthetic rubber. The first large application was in the production of tablecloths in the late 1940's. About that time the first latex paint was introduced commercially. During the 1950's another large market developed, namely in coating formulations, clay, and in a variety of paper and paperboard products.

However, the largest market for SB Latexes developed in the 1960's. That was in the tufted rug industry, which was growing at that time at a rate of almost 20% per year. The advent of self-cure or carboxylated SB Latexes enabled the successful use of carpet-backing compounds.

Some other applications include non-woven binders, adhesives, textile inks, and in building products.

Significant producers are: Dow, General Tire & Rubber, Goodyear, W.R. Grace, Hooker, Monsanto, Morton Industries, Polysar, Reichhold, Union Chemical and USS Chemicals.

Production and Sales & Captive Use
(thousands of pounds)

		Sales & Captive Use				
Year	Production	Paper Treating	Textile Treating	Carpet Backing	All Other	Total
1977	675,660	56,313	39,436	325,896	239,229	660,874
1978	722,264	79,511	29,739	347,860	261,797	718,907
1979	736,866	21,694	24,644	360,961	328,708	736,007
1980	631,816	27,445	24,734	293,059	286,805	632,043
1981	674,188	32,024	28,152	258,740	331,617	650,533

Source: Monthly Statistical Report, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31:[1] (millions of pounds) 1981	1982	1983
ARCO/Polymers	400	400	400
Chemplex Company	410	410	410
Cities Service Company*	725	—	—
Dow Chemical U.S.A.	1,175	1,175	1,400
DuPont, E.I. de Nemours & Co.	700	700	700
Eastman Chemical Products	350	350	550
El Paso Polyolefins	550	570	570
Exxon Chemical U.S.A.	740	1,275	1,275
Gulf Oil Chemicals	850	850	850
Mobil Chemical Company	300	300	750
Northern Petrochemical Company	560	560	560
Union Carbide Corp.	2,300	2,450	2,450
U.S. Industrial Chemicals Company	700	700	700
Total	9,760	9,740	10,615

[1]Includes Linear Low Density

*Closed down their plastics operations in 1982.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	6,471	6,488
1978	7,111	7,147
1979	7,793	7,815
1980	7,291	7,467
1981	7,693	7,516
Compound Growth Rate 1976-1981	5.8%	5.4%

	Percent of Total U.S. Sales & Captive Use
1977	20.86
1978	20.38
1979	20.19
1980	21.22
1981	20.34

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Film (12 mils & below)	3,659	4,018	4,363	4,004	4,077
Sheet (over 12 mils)	28	28	26	18	14
Injection molding	601	601	650	519	524
Wire & cable	404	422	424	335	347
Extrusion coating	478	489	5[illegible]9	517	564
Blow molding	54	56	60	65	60
Pipe & conduit	27	26	33	22	25
Other extruded products	59	68	80	56	60
All other uses	603	682	742	784	862
Total	5,913	6,390	6,917	6,320	6,533

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	68	55	56	*	53
Packaging	3,944	4,462	4,796	4,582	4,602
Building/Construction	217	233	245	186	148
Electrical/Electronic	443	492	500	416	431
Furniture/Furnishings	*	*	*	15	15
Consumer & Institutional	696	681	672	570	598
Industrial/Machinery	71	*	*	*	*
Adhesives, Inks & Coatings	*	55	27	*	*
All Other	475	412	621	551	685
Exports	574	757	898	1,147	984
Total	6,488	7,147	7,815	7,467	7,516

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

NYLON

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1981	1982	1983
Adell Plastics, Inc.	20	20	20
Allied Corp.	70	70	70
American Grilon div Emser	11	11	11
American Hoechst Corp.	20	20	20
Badische Corp.	15	15	15
Belding Chemical Industries	4	4	4
Celanese Plastics & Specialities Company	40	40	40
Custom Resins, div. Bemis Co.	20	20	20
DuPont, E.I. de Nemours & Co.	160	160	160
Firestone Fibers & Textiles Co.	14	14	14
Monsanto Company	70	70	70
Rilsan Corp.	11	18	18
Shakespeare Co.	4	4	4
Wellman, Inc.	10	10	10
Total	469	476	476

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	254	250
1978	275	278
1979	327	315
1980	274	271
1981	312	288
Compound Growth Rate 1976-1981	4.8%	5.4%

	Percent of Total U.S. Sales & Captive Use
1977	0.80
1978	0.79
1979	0.81
1980	0.77
1981	0.78

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

NYLON
DOMESTIC CONSUMPTION BY END-USE
(in thousands of pounds)

End-use	1977	1978	1979	1980	1981
Automotive and truck	82,968	93,494	100,878	77,972	89,115
Electrical and Electronic[1]	25,942	29,348	42,691	34,792	32,857
Appliances	11,090	14,070	14,684	7,061	8,549
Film and Coating	20,204	20,631	24,202	27,918	28,740
Wire and Cable	11,556	12,755	15,500	16,824	18,999
Monofilament	17,620	8,089	11,417	11,928	15,593
Consumer[2]	18,844	15,954	19,569	21,120	16,533
Others	46,068	62,714	56,414	50,434	59,159
Total	234,292	257,055	285,355	248,049	269,545

[1]Includes electrical and electronic applications not assignable to automotive and truck or appliance markets.
[2]Includes such items as housewares, brushes, combs, sporting goods, cameras and toys.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	88	99	96	81	92
Packaging	22	24	31	28	32
Building/Construction	2	3	9	*	*
Electrical/Electronic	47	55	59	53	57
Furniture/Furnishings	*	*	*	8	8
Consumer & Institutional	18	16	15	17	17
Industrial/Machinery	15	19	26	20	26
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	41	41	50	41	37
Exports	17	21	29	23	19
Total	250	278	315	271	288

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYPROPYLENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1981	1982	1983
Amoco Chemicals	570	570	570
ARCO/Polymers	400	400	400
Eastman Chemical Products, Inc.	140	140	140
El Paso Polyolefins Co.	275	255	255
Exxon Chemical U.S.A.	260	260	260
Gulf Oil Chemicals Company	400	400	400
Hercules Incorporated	1,310	1,310	1,310
Northern Petrochemical Company	180	180	180
Phillips Petroleum Company	200	200	200
Shell Chemical Company	600	600	600
Soltex Polymer Corp.	200	200	200
USS—Novamont Corp.	515	515	515
Total	5,050	5,030	5,030

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	2,747	2,698
1978	3,074	3,055
1979	3,841	3,894
1980	3,648	3,714
1981	3,955	3,888
Compound Growth Rate 1976-1981	8.5%	8.9%

	Percent of Total U.S. Sales & Captive Use
1977	8.67
1978	8.71
1979	10.05
1980	10.56
1981	10.52

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYPROPYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Injection molding, total	990	1,062	1,219	1,119	1,243
Appliances	94	93	99	87	94
Consumer products	157	178	278	301	359
Rigid packaging	179	185	208	225	266
Transportation	371	392	350	252	247
All other injection molding	189	214	284	254	277
Blow molding	50	59	62	63	65
Film (10 mils & below)	204	239	282	298	303
Sheet	30	29	31	36	35
Other extruded products (including wire & cable, pipe & conduit, and extrusion coating)	81	79	97	84	99
Fiber & filaments	758	852	1,020	963	1,036
All other uses	302	371	469	472	421
Total	2,415	2,691	3,180	3,035	3,202

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	322	322	260	230	266
Packaging	421	477	722	720	812
Building/Construction	32	*	*	*	*
Electrical/Electronic	197	215	210	196	248
Furniture/Furnishings	472	564	759	727	813
Consumer & Institutional	504	518	539	505	487
Industrial/Machinery	*	34	54	52	56
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	468	561	636	604	521
Exports	282	364	714	680	685
Total	2,698	3,055	3,894	3,714	3,888

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYSTYRENE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1981	1982	1983
A & E Plastic Pak	20	20	20
American Hoechst Corp.	600	600	600
Amoco Chemicals Corp.	400	400	400
ARCO/Polymers	450	450	450
BASF Wyandotte Corp.	180	180	180
Cosden Oil & Chemical Company	450	450	500
Dow Chemical Corp.	1,000	1,000	1,000
Carl Gordon Industries	100	100	100
Gulf Oil Chemicals	300	300	425
Huntsman-Goodson Chemical Co.	20	20	20
Kama Corp.	20	30	30
Mobil Chemical Corp.	200	200	450
Monsanto Company	775	775	775
Polysar Group	275	275	275
Shell Chemical Company	300	300	300
Texstyrene Co. (ETI)	10	10	10
USS Chemicals	75	—	—
Vititek	5	5	5
Total	5,180	5,115	5,540

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	3,446	3,557
1978	3,823	3,870
1979	4,005	3,997
1980	3,521	3,518
1981	3,621	3,604
Compound Growth Rate 1976-1981	2.5%	2.8%

	Percent of Total U.S. Sales & Captive Use
1977	11.44
1978	11.04
1979	10.32
1980	10.00
1981	9.75

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYSTYRENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Straight Polystyrene	1,703	1,828	1,906	1,761	1,793
Rubber-Modified Polystyrene	1,855	2,042	2,091	1,757	1,811
Total	3,558	3,870	3,997	3,518	3,604
Molding	1,718	1,814	1,901	1,596	1,638
Extrusion	1,132	1,245	1,314	1,083	1,142
Expandable Polystyrene Beads	385	407	445	431	416
All Other Uses	206	247	175	240	257
Total Domestic	3,441	3,713	3,835	3,350	3,453

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	*	21	23	13	16
Packaging	1,248	1,401	1,424	1,349	1,494
Building/Construction	350	320	350	277	273
Electrical/Electronic	354	375	383	301	360
Furniture/Furnishings	134	129	118	74	62
Consumer & Institutional	794	876	927	779	756
Industrial/Machinery	39	26	26	*	*
Adhesives, Inks & Coatings	*	—	—	*	*
All Other	522	566	585	557	493
Exports	116	156	161	168	150
Total	3,557	3,870	3,997	3,518	3,604

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL CHLORIDE

Manufacturing

Known Manufacturers	Estimated Capacity as of December 31: (millions of pounds) 1981	1982	1983
Air Products & Chemicals	360	150	150
Borden Chemical Company, The	500	500	800
Certain-Teed Products Corp.	220	220	220
Conoco Chemicals	715	715	715
Diamond Shamrock Corp.[1]	100	—	—
Ethyl Corp.	180	325	325
Formosa Plastics	160	825	825
General Tire & Rubber Company	165	165	165
Georgia-Pacific Corp.	700	700	700
B.F. Goodrich Chemical Company, The	1,500	1,850	1,850
Goodyear Tire & Rubber Company, The	70	70	70
Great American Chemical div. (Whittaker Corp.)[2]	60	—	—
Hooker Chemicals & Plastics	725	750	750
Keysor-Century Corp.	20	50	50
Pantasote Co. of New York, The[2]	120	—	—
Shintech, Inc.	600	600	600
Stauffer Chemical Company[3]	375	—	—
Tenneco Chemicals	900	900	900
Union Carbide Corp.	145	145	145
Total	7,615	7,965	8,265

[1]Sold plants to Goodrich in 1981; Ethyl in 1982.

[2]Closed down in 1982.

[3]Sold plant to Formosa in 1982.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

Production and Sales & Captive Use (millions of pounds)

Year	Production	Sales & Captive Use
1977	5,253	5,232
1978	5,723	5,810
1979	6,119	6,138
1980	5,470	5,407
1981	5,707	5,601
Compound Growth Rate 1976-1981	3.9%	3.9%

	Percent of Total U.S. Sales & Captive Use
1977	16.82
1978	16.57
1979	15.85
1980	15.37
1981	15.16

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL CHLORIDE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

End-use	1977	1978	1979	1980	1981
Calendering, total	664	667	719	623	666
Flooring	171	153	173	138	147
Textile	152	146	110	94	73
All other calendering	341	368	436	391	446
Coating, total	488	532	489	370	314
Flooring	158	181	186	125	123
Textile & paper coating	153	141	138	119	100
Protective coatings	96	123	83	67	41
Adhesives & all other coatings	81	87	82	59	50
Extrusion, total	2,883	3,254	3,514	2,978	3,149
Wire & cable	384	400	409	368	367
Film & sheet	238	255	292	253	287
Rigid pipe & tubing (except fittings)	1,818	2,099	2,323	1,865	2,033
All other extrusions	443	500	490	492	462
Molding, total	468	535	503	415	372
Bottles	75	94	82	98	92
Sound records	175	211	160	114	104
Fittings (rigid pipe & tubing)	86	117	113	92	102
All other molding	132	113	148	111	74
Paste processes (except coating), total	164	169	184	154	182
Plastisol formulation	93	88	93	81	99
All other	71	81	91	73	83
Resellers	80	89	76	86	140
All other uses	246	321	331	316	342
Grand total	4,993	5,567	5,816	4,942	5,165

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

Major Market	1977	1978	1979	1980	1981
Transportation	219	278	270	195	177
Packaging	416	394	525	410	424
Building/Construction	2,644	3,150	3,167	2,690	2,891
Electrical/Electronic	602	643	623	539	583
Furniture/Furnishings	202	300	320	216	171
Consumer & Institutional	402	428	485	427	434
Industrial/Machinery	20	23	38	16	19
Adhesives, Inks & Coatings	141	103	92	79	56
All Other	347	248	296	370	410
Exports	239	243	322	465	436
Total	5,232	5,810	6,138	5,407	5,601

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL ACETATE

Polyvinyl acetate is produced by the emulsion polymerization of vinyl acetate to yield a water emulsion with a solids content of 50-55%. Commercial exploitation of this polymer began in the early 1930's, although its discovery dates from the early 1900's. Early production of the resin was primarily as a homopolymer, but more recently resin properties have been changed by including comonomers as n-butyl acrylate, 2-ethylhexyl acrylate, ethylene, dibutylmaleate, and dibutyl fumarate. Because of the large number of polyvinyl acetate producers, the numerous copolymers included and the variety of physical forms, polyvinyl acetate production is reported to SPI in terms of vinyl acetate monomer sold to or used by the polymerizer.

Polyvinyl acetate resins are primarily used in aqueous emulsions and find utility in adhesives, paints, textile finishes, and paper coating applications. A typical example of a polyvinyl acetate emulsion is the "white glue" used in many homes and schools.

There are more than 50 producers of polyvinyl acetate, supplied with monomer by such companies as Borden, Celanese Chemical, DuPont, National Starch, Union Carbide, and U.S. Industrial Chemicals.

SALES AND CAPTIVE USE OF VINYL ACETATE MONOMER FOR POLYVINYL ACETATE (thousands of pounds)

	Emulsion				Non-woven			
Year	Paint	Adhesives	Paper	Textile	Binders	Others	Export	Total
1977	231,479	268,175	76,565	30,249	16,416	42,447	12,244	677,575
1978	237,915	280,573	85,268	25,284	23,102	41,811	16,216	710,169
1979	287,617	257,520	87,627	28,935	30,062	46,513	20,782	759,056
1980	224,587	262,431	88,372	33,014	30,991	43,292	18,306	700,993
1981	179,531	263,205	85,465	26,666	29,865	42,357	14,557	641,646

Compound Growth Rate Total Sales & Captive Use	
1976-1981	−0.6%
1980-1981	−8.5%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL ALCOHOL

Polyvinyl alcohol was first prepared by Herrman and Haehnel in Germany in 1924 with commercial production beginning in the U.S. in the early 1930's. Polyvinyl alcohol is a unique polymer in that its monomer, vinyl alcohol, does not exist. It is produced from polyvinyl acetate by hydrolysis in either a batch or continuous process. This reaction can be controlled so that any degree of replacement of the acetate groupings can be produced. The degree of hydrolysis affects the resin properties such as water solubility, solvent resistance, adhesive strength, and other properties. Polyvinyl alcohol is primarily used as the fully-hydrolyzed product.

The principal uses of polyvinyl alcohol are in textile warp sizing, adhesive manufacture, as a suspending aid in polymerization, paper coatings, as an intermediate in the manufacture of polyvinyl butyral and in a variety of minor applications ranging from cosmetic manufacture to soil erosion control. The major manufacturers of polyvinyl alcohol in the U.S. are DuPont, Air Products, and Monsanto.

Production and Sales & Captive Use
(thousands of pounds)

		Sales & Captive Use		
Year	Production	Domestic	Export	Total
1977	119,217	112,997	5,262	118,259
1978	126,967	119,882	13,359	133,241
1979	147,702	123,857	24,451	148,308
1980	140,619	115,177	13,151	128,328
1981	138,898	114,355	20,393	134,748

Compound Growth Rate
Total Sales & Captive Use

1976-1981	4.2%
1980-1981	5.0%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

OTHER VINYL RESINS

Vinyl resins included in this category are polyvinyl butyral, polyvinyl formal, and polyvinylidene chloride and their respective copolymers containing at least 50% of the base resin.

Polyvinyl butyral and polyvinyl formal are prepared by reacting polyvinyl alcohol with butyraldehyde or formaldehyde in the presence of a strong mineral acid. There are many grades of these products in use, differing in degree of hydroxyl substitution and molecular weight. The largest end use of polyvinyl butyral is as the adhesive film in the lamination of auto safety glass. The major use of polyvinyl formal is in magnet wire coatings.

Polyvinylidene chloride is prepared by suspension or emulsion polymerization of vinylidene chloride. It finds major application as a film or as a coating on flexible substrates for packaging food products where oxygen impermeability and oil resistance are important.

Producers of these vinyl resins include Dow, DuPont, B.F. Goodrich, W.R. Grace, Monsanto, Morton Industries, Rohm and Haas, Union Carbide and Union Chemical.

Production and Sales & Captive Use
(thousands of pounds)

Year	Production	Sales & Captive Use
1977	196,763	193,893
1978	196,742	190,763
1979	220,154	212,779
1980	196,235	192,638
1981	208,201	198,903

Compound Growth Rate of Sales & Captive Use

1976-1981	−1.0%
1980-1981	3.3%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MISCELLANEOUS THERMOPLASTICS
(millions of pounds)

	Production				
Resin	**1976**	**1977**	**1978**	**1979**	**1980**
Acrylics	888	967	1,086	1,142	1,028
Cellulosics	n.a.	356	468	480	n.a.
Petroleum hydrocarbons	306	334	319	321	264
Non-nylon polyamides	31	41	33	35	46
Polyterpenes	13	14	15	30	41
Rosin modifications	64	47	41	94	182
Other[1]	443	115	169	188	406

	Sales				
Resin	**1976**	**1977**	**1978**	**1979**	**1980**
Acrylics	n.a.	n.a.	n.a.	n.a.	n.a.
Cellulosics	n.a.	228	n.a.	333	n.a.
Petroleum hydrocarbons	293	332	309	301	253
Non-nylon polyamides	28	40	33	34	42
Polyterpenes	13	14	15	30	36
Rosin modifications	63	47	42	85	177
Other[1]	1,043	862	883	667	791

n.a. = not available

[1]Includes acrylic (sales only), chlorinated polyolefins, coumarone-indene, fluoropolymers, polybutylene, polyphenyl aromatic esters, and other thermoplastics. Cellulosics also included in 1976 & 1980.

Source: *Synthetic Organic Chemicals,* U.S. International Trade Commission.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE
(millions of pounds)

Material/Year	Total	Injection Molding	Extrusion	Blow Molding	Other
Grand Total					
1977	21,156	4,995	10,882	1,437	3,842
1978	23,373	5,354	12,149	1,670	4,200
1979	25,443	6,010	13,143	1,928	4,362
1980	22,621	5,078	11,631	1,799	4,113
1981	23,693	5,233	12,245	1,913	4,302
Growth Rate 1976-1981	5.0%	2.8%	5.8%	7.8%	4.3%
Polyolefins					
1977	11,459	2,273	6,359	1,362	1,465
1978	12,755	2,465	7,014	1,576	1,700
1979	14,382	2,943	7,748	1,846	1,845
1980	13,222	2,576	7,116	1,701	1,829
1981	13,957	2,764	7,463	1,821	1,909
Growth Rate 1976-1981	6.6%	5.3%	6.2%	8.1%	9.1%
LD Polyethylene					
1977	5,914	601	4,655	54	604
1978	6,390	601	5,051	56	682
1979	6,917	650	5,465	60	742
1980	6,320	519	4,952	65	784
1981	6,533	524	5,087	60	862
Growth Rate 1976-1981	4.7%	−1.9%	4.8%	3.3%	9.2%
HD Polyethylene					
1977	3,130	682	631	1,258	559
1978	3,674	802	764	1,461	647
1979	4,285	1,074	853	1,724	634
1980	3,867	938	783	1,573	573
1981	4,222	997	903	1,696	626
Growth Rate 1976-1981	8.9%	9.2%	11.8%	8.1%	6.6%
Polypropylene					
1977	2,415	990	1,073	50	302
1978	2,691	1,062	1,199	59	371
1979	3,180	1,219	1,430	62	469
1980	3,035	1,119	1,381	63	472
1981	3,202	1,243	1,473	65	421
Growth Rate 1976-1981	8.0%	6.2%	8.1%	11.9%	13.4%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

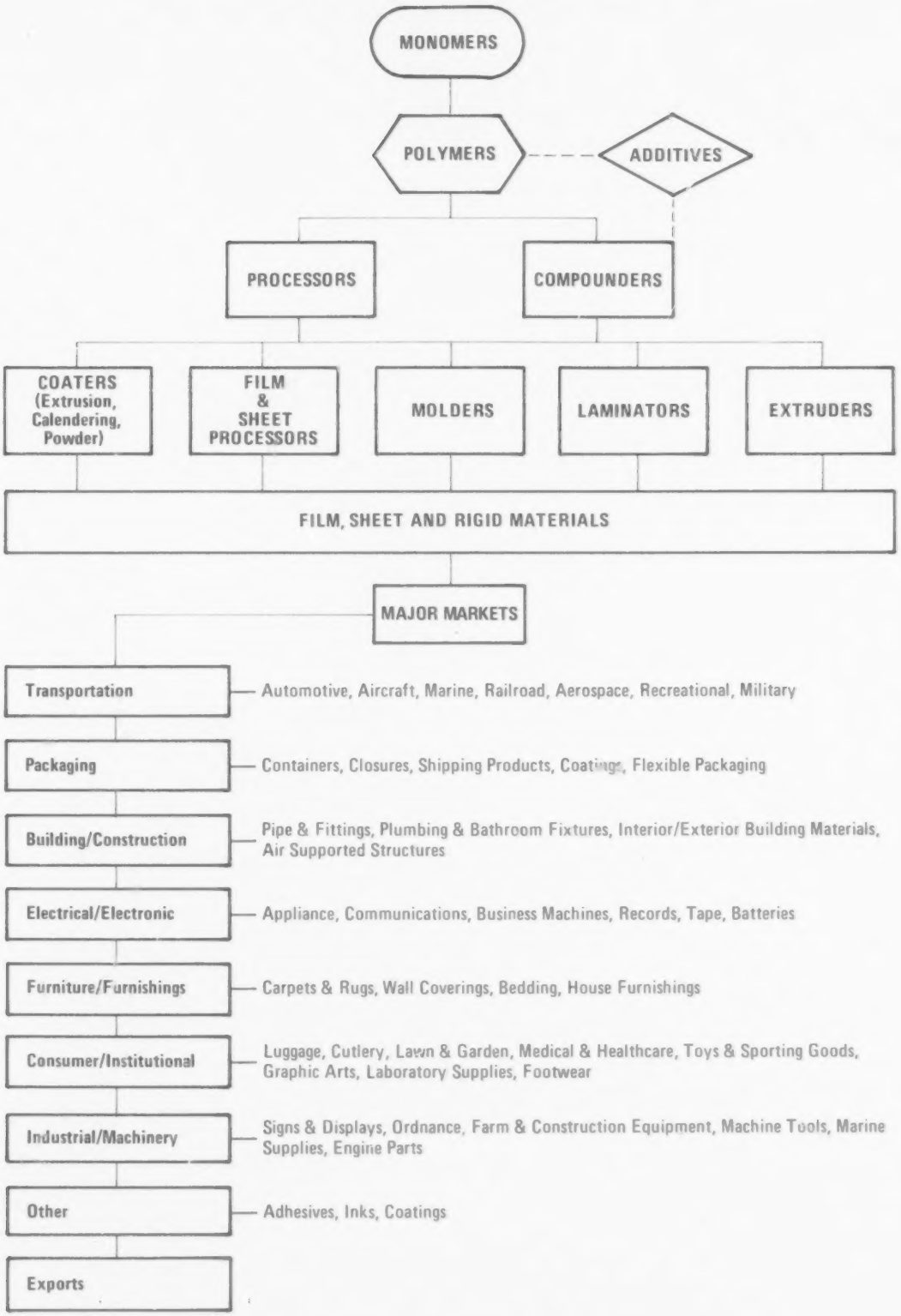
DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE (Cont'd.)
(millions of pounds)

Material/Year	Total	Injection Molding	Extrusion	Blow Molding	Other
A B S					
1977	1,029	533	451	—	45
1978	1,081	455	579	—	47
1979	1,124	550	500	—	74
1980	859	420	380	—	59
1981	848	373	415	—	60
Growth Rate 1976-1981	– 1.1%	– 3.8%	3.6%	—	– 8.8%
Polystyrene					
1977	3,441	1,718	1,132	—	591
1978	3,713	1,814	1,245	—	654
1979	3,836	1,901	1,314	—	621
1980	3,350	1,596	1,083	—	671
1981	3,453	1,638	1,142	—	673
Growth Rate 1976-1981	2.9%	0.9%	4.6%	—	5.6%
Nylon					
1977	234	163	57	—	14
1978	257	179	57	—	21
1979	285	195	67	—	23
1980	248	169	74	—	5
1981	270	178	76	—	16
Growth Rate 1976-1981	5.8%	5.8%	3.2%	—	26%
P V C					
1977	4,993	308	2,883	75	1,727
1978	5,567	441	3,254	94	1,778
1979	5,816	421	3,514	82	1,799
1980	4,942	317	2,978	98	1,549
1981	5,165	280	3,149	92	1,644
Growth Rate 1976-1981	3.4%	0.7%	5.7%	3.4%	0.1%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

FABRICATED PLASTIC PRODUCTS

FLOW CHART: FROM RAW MATERIAL TO FINAL PRODUCT



Source: SPI, Committee on Resin Statistics, *Major Markets Manual.*

REINFORCED PLASTICS

The combination of thermosetting unsaturated polyester resins with glass fiber accounts for the bulk of reinforced plastics products. Phenolics, vinyl esters, epoxies and fumarate resins bring thermosets' share of the market to almost 90%. The thermoplastics which account for the remainder, in general relative importance, are polyolefins, nylon, polycarbonate, styrenics, and polyvinyl chloride.

Random glass fibers are the volume reinforcement, but beads, flake, and woven mat and roving are other forms in which the glass may be used. For very high-performance or unique applications such as required in aerospace parts, or sporting goods shafts, carbon and graphite or certain synthetic fibers have a growing use experience. By weight the reinforcement is usually 25-35%, but 50% is not unusual in spray-up or press-molded materials.

Thermoset materials have been the choice for impact-strength, higher resistance to heat distortion, and resistance to corrosive environments. Thermoplastics are developing where large runs of uniform parts are a requirement, and where relatively smaller size of the parts makes processing feasible. In the last two years the reinforcement of foamed parts has become a reality in several markets.

Reinforced plastics production at the outset, during World War II, was almost entirely for military use such as in radomes. In recent years the marine market has dominated consumption, but even though its projected growth is 75% over the next five years it will probably soon take second place to transportation. The use of RP in automobiles could double over the next four years. The other high-volume growth market in the immediate future is chemical-resistance and pipeline application. All of the use categories for reinforced plastics are slated for faster growth than the economy generally.

The reinforced plastics industry enjoys a high level of technical activity because of the engineered nature of its products, and the relatively high value-added nature of the finished product. The search for new applications is vigorous, while new levels of performance in existing uses are continually being refined. Environmental and health concerns about styrene monomer, as well as continued demands of fire-retardant and non-toxic materials, suggest that research on basic resin characteristics will also continue.

The structure of the reinforced plastics industry has stabilized in recent years. Several materials suppliers have, in the pattern of other domestic industries, "integrated forward" by acquiring or developing fabrication divisions which specialize in a given manufacturing process or market, such as panels for light construction, corrosion-resistant equipment, or sanitaryware. More common, however, has been the development by large corporations identified with a given market, such as industrial pipe, automotive parts, or marine equipment, of a "captive" reinforced plastics operation which complements or replaces their metal or woodworking manufacturing. In the last decade custom molders have attempted to stabilize their role by selecting to produce several types of parts which they handle especially well, but spreading these selections over several market areas to minimize uneven business cycles. There have, of course, emerged large and small manufacturing companies who independently specialize in a given process or product. To complete the picture of the RP industry's diversity, we must mention that there is still room for the inventor/entrepreneur and, at the other end of the development process, there continues to be a considerable degree of university and laboratory research.

REINFORCED PLASTICS SHIPMENTS BY MARKET
(Thermoset & Thermoplastic Resins)

	Shipments (in millions of pounds)					
Markets	**1977**	**1978**	**1979**	**1980**	**1981[1]**	**1982[2]**
Aircraft & Aerospace	23	22	23	25	28	31
Appliances & Equipment	112	123	130	104	112	117
Construction	276	323	335	287	309	327
Consumer Goods	116	116	126	103	110	118
Corrosion-Resistant Products	189	216	238	252	275	302
Electrical Rods, Tubes, Parts	154	170	190	162	178	196
Marine & Marine Accessories	400	430	385	275	290	290
Land Transportation	460	532	550	416	445	457
Miscellaneous	72	74	79	70	74	78
Total	1,802	2,006	2,056	1,694	1,821	1,916

[1] = estimate
[2] = forecast

Source: SPI's Reinforced Plastics/Composites Institute.

By taking advantage of the manufacturing benefits of fiber glass reinforced plastic (FRP), engineers have made these RV's famous for their sleek lines, aerodynamic styling and durability. The high insulation qualities of fiber glass and foam also assures efficient heating during the coldest of winters.

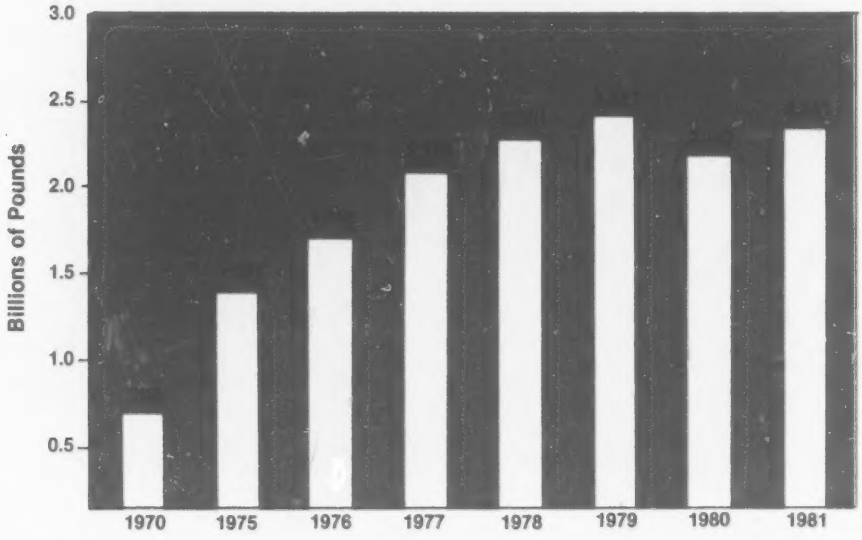
Courtesy: Plastics World Magazine/Owens-Corning Fiberglas

PLASTICS PIPE AND FITTINGS

In 1981, overall shipments of thermoplastic pipe and fittings rose 5.6% as compared with 1980. Plastic pipe consumption rose 5.6% while fittings were up 5.9%. All figures exclude corrugated polyethylene pipe.

Plastics pipe shipments increased to 2.2 billion pounds from 2.1 billion pounds in 1980. Plastics fittings volume rose to 149 million pounds in 1981 versus 142 million pounds the year earlier.

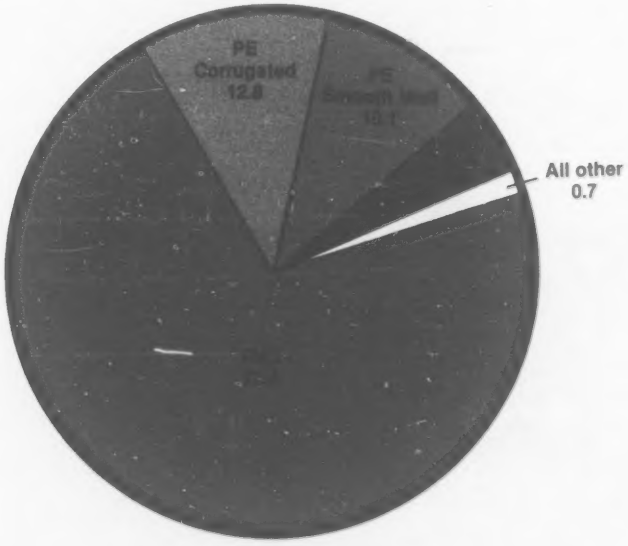
U.S. PLASTICS PIPE AND FITTINGS SHIPMENTS 1970-1981



Source: SPI Plastic Pipe Institute and Committee on Resin Statistics

Market Share

Polyvinyl chloride (PVC) enjoyed by far the largest share of all plastics materials going into pipe and fittings applications. In 1981 PVC accounted for 72.6% of all pipe shipments. This was slightly more than PVC's share of a year earlier when it had 71.1%. The chart below shows the 1981 distribution of plastics pipe shipments by material. Corrugated polyethylene pipe is estimated at 324 million pounds in 1981.



U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY MATERIAL
(in millions of pounds)

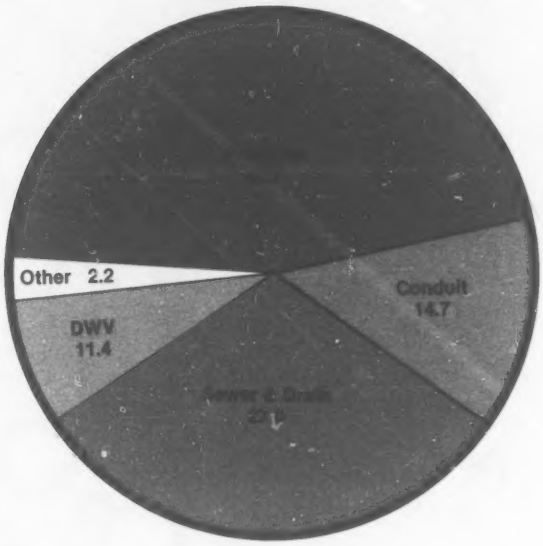
Year	Total	PVC	ABS	PE[1]	Other
1977	1,992	1,612	211	155	14
1978	2,114	1,765	180	156	13
1979	2,254	1,860	185	197	12
1980	2,085	1,713	125	235	12
1981	2,202	1,834	97	256	15
Growth Rate 1976-1981	7.2%	8.1%	−11.0%	14.9%	1.4%

[1]Excludes corrugated

U.S. PLASTIC PIPE SHIPMENTS BY MATERIAL 1981 vs 1980
(in millions of pounds)

Material	1981	1980	Change	% Change
PVC	1,834	1,713	+121	+7.1%
ABS	97	125	−28	−22.4
PE (Smooth wall)	256	235	+21	+8.9
Other	15	12	+3	+25.0
Total	2,202	2,085	+117	+5.7%

DISTRIBUTION OF PLASTICS PIPE SHIPMENTS BY APPLICATION—1981

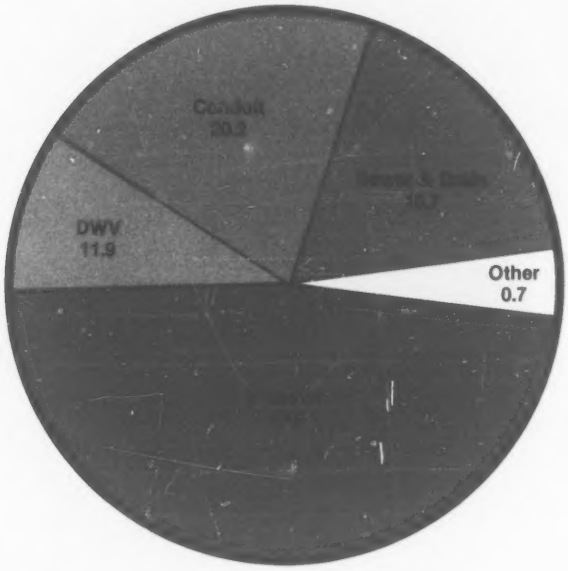


U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY APPLICATIONS
(in millions of pounds)

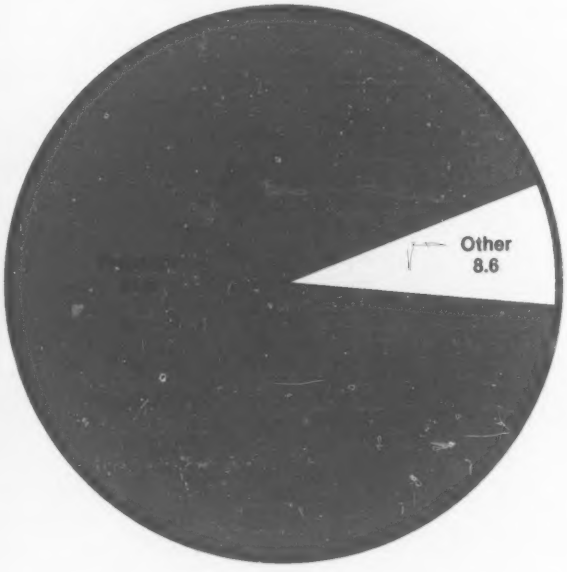
Year	Total	Pressure	Conduit	DWV	Other
1977	1,992	972	268	368	384
1978	2,114	962	358	329	465
1979	2,254	1,058	406	313	477
1980	2,085	1,048	370	289	378
1981	2,202	1,130	370	289	413
Growth Rate 1976-1981	7.2%	8.0%	11.8%	0.4%	7.1%

DWV = Drain, Waste & Vent

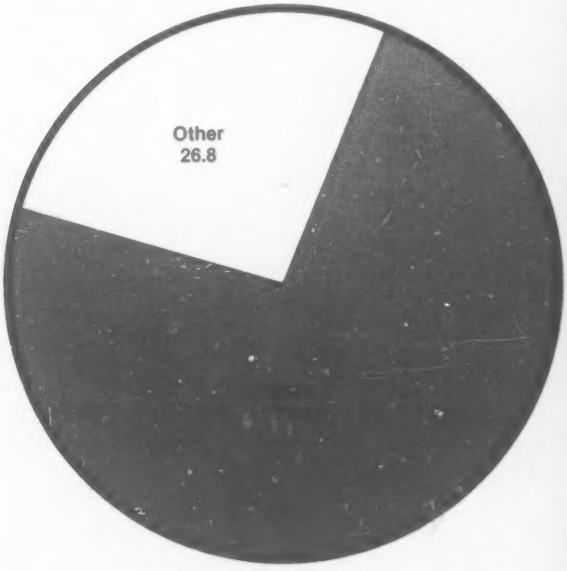
DISTRIBUTION OF PVC PIPE SHIPMENTS BY APPLICATION—1981



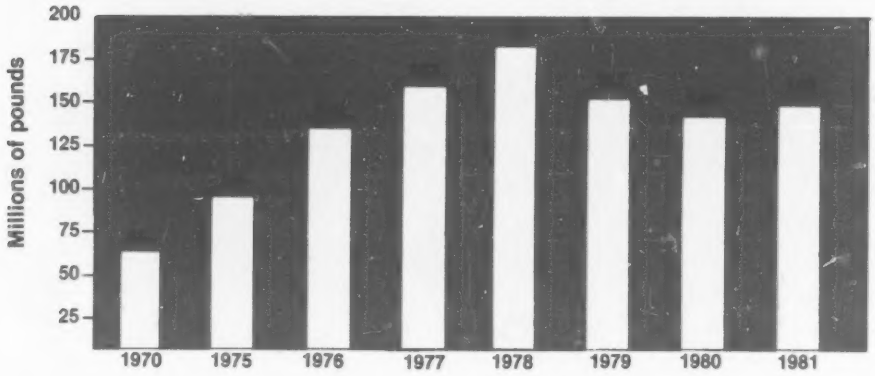
DISTRIBUTION OF POLYETHYLENE PIPE SHIPMENTS BY APPLICATION—1981



DISTRIBUTION OF ABS PIPE SHIPMENTS BY APPLICATION—1981



U.S. PLASTICS FITTINGS SHIPMENTS: 1970-1981



Source: SPI Plastic Pipe Institute and Committee on Resin Statistics.

U.S. PLASTICS FITTINGS SHIPMENTS BY MATERIAL
(millions of pounds)

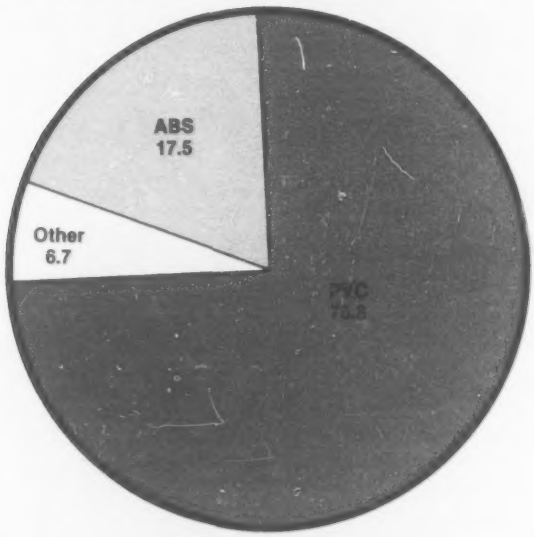
Year	Total	PVC	ABS	Other*
1977	163	103	52	8
1978	187	118	59	10
1979	157	109	38	10
1980	142	103	30	9
1981	149	113	26	10
Growth Rate 1976-1981	2.3%	6.6%	−9.1%	2.1%

*Includes polyethylene, chlorinated PVC, polyacetal, etc.

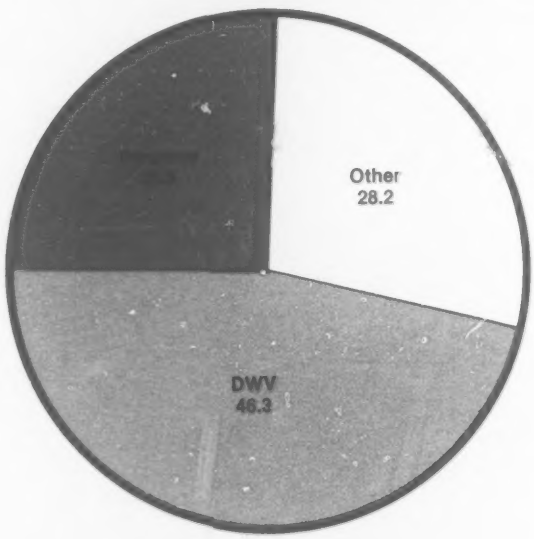
U.S. PLASTICS FITTINGS BY APPLICATION
(in millions of pounds)

Year	Total	Pressure	DWV	Other Non-Pressure
1977	163	28	104	31
1978	187	32	117	38
1979	157	36	81	40
1980	142	34	68	40
1981	149	38	69	42
Growth Rate 1976-1981	2.3%	10.6%	−3.9%	10.1%

DISTRIBUTION OF PLASTICS FITTINGS BY MATERIAL-1981



DISTRIBUTION OF PLASTICS FITTINGS BY APPLICATION—1981



MAJOR MARKETS

DEFINITIONS

The primary product groups for each Major Market category are listed below:

A. TRANSPORTATION
Motor Vehicles and Parts: including autos, trucks, buses, motorcycles, and bicycles. Ships, boats and recreational vehicles.
All Other: including railroad equipment, travel trailers, campers, golf carts, snowmobiles, aircraft, military vehicles.

B. PACKAGING
Bottles, Jars, Vials
Food Containers: including disposable cups
Blister and Bubble Containers
Flexible Packaging: including household and institutional refuse bags and film
All Other: including tubes, tape, strapping, drums, caps, baskets, trays, boxes. pallets, shipping crates.

C. BUILDING AND CONSTRUCTION
Pipe, Conduit and Fittings: including drainage, irrigation, plumbing fixtures, septic tanks.
Building Material for all Structures: including siding, flooring, and insulation materials.
All Other: including panels, doors, windows, skylights, bathroom units, gratings and railings.

D. ELECTRICAL AND ELECTRONIC
Home and Industrial Appliances: including electrical industrial equipment, wire and cable coverings, communications equipment.
Electronic Components: including resistors, magnetic tape, records, and batteries.

E. FURNITURE AND FURNISHINGS
All Types: including household and office furniture, bedding, carpets, rugs, backing, curtains, blinds, awnings, lamps, picture frames, wall coverings.

F. CONSUMER AND INSTITUTIONAL PRODUCTS
Dinner and Kitchenware: including picnicware.
Toys and Sporting Goods
Health Care and Medical Products: including laboratory supplies.
Hobby and Graphic Arts Supplies: including photographic equipment and supplies.
All Other: including footwear, luggage, buttons, lawn & garden tools, signs and displays, credit cards.

G. INDUSTRIAL/ MACHINERY
All Types: including engine and turbine parts, farm and garden machinery, construction and related equipment, machine tools, ordnance and firearms, chemical process equipment.

H. ADHESIVES/INKS/COATINGS
Adhesives and Sealants
All Other: including printing ink, magnet wire enamels, core binders, foundry facings, paper coating and glazing, paints, varnishes, and enamels.

I. RESELLERS/COMPOUNDERS
Sales of Resins Sold to Resellers, Compounders, Converters.
Unclassified Sales: including calenderers whose end-use markets cannot be ascertained by the resin supplier, or resin that cannot be classified under any of the Major Market categories listed above.

J. EXPORTS
Sales of Plastic Resin exported from the U.S.

1981 RESULTS

The 1981 data reflect major market plastics resins sales and captive use data compiled by Ernst & Whinney with consumption data being reported by individual resin. The plastics resins categories included in this study are:

THERMOSETS

- Epoxy
- Polyester, Unsaturated
- Urea and Melamine
- Phenolic
- All Other Thermosets

THERMOPLASTICS

- Low Density Polyethylene
- High Density Polyethylene
- Polypropylene
- Acrylonitrile-Butadiene-Styrene (ABS) and Styrene-Acrylonitrile (SAN)
- Polystyrene
- Styrene Butadiene Latexes (SBL), and Other Styrene Based Latexes (OSBL), and Other Styrene Based Polymers (OSBP)
- Nylon
- Polyvinyl Chloride
- Thermoplastic Polyester
- All Other Thermoplastics

In addition, sales and captive use of polyurethane are reported separately by Major Market total only in an appendix to this report.

COMPARISON OF 1981 DATA TO PRIOR YEARS
FIVE YEAR COMPARISON OF RESIN SALES & USE BY MAJOR MARKET*
(millions of pounds, dry weight basis)**

Major Market	1977	1978	1979	1980	1981
Transportation	1,911	2,015	1,934	1,605	1,573
Packaging	7,889	9,044	10,334	10,003	10,465
Building/Construction	6,008	6,965	7,573	6,424	7,259
Electrical/Electronic	2,756	2,952	3,043	2,453	2,670
Furniture/Furnishings	1,391	1,686	1,894	1,646	1,670
Consumer & Institutional	3,242	3,592	3,753	3,553	3,670
Industrial/Machinery	472	380	517	391	393
Adhesives, Inks & Coatings	2,566	2,902	2,794	2,387	2,572
All Other	2,728	2,939	3,443	3,054	3,259
Exports	2,142	2,588	3,432	3,670	3,425
Total	31,105	35,063	38,717	35,186	36,956

*Note: All figures exclude polyurethane

**Phenolic resins reported on gross weight basis beginning in 1981.

SHARE OF MARKET

The data reported by the Major Markets Subcommittee enables one to determine the fastest growing plastics markets. The data show, for example, the increasing role of "packaging" as a consumer of plastics resins in 1981.

COMPARATIVE PERCENTAGE DISTRIBUTION BY MAJOR MARKET

Major Market	1977	1978	1979	1980	1981
Transportation	6.1%	5.7%	5.0%	4.6%	4.3%
Packaging	25.4	25.8	26.7	28.4	28.3
Building/Construction	19.3	19.8	19.6	18.3	19.6
Electrical/Electronic	8.9	8.4	7.9	7.0	7.2
Furniture/Furnishings	4.5	4.8	4.9	4.7	4.5
Consumer & Institutional	10.4	10.3	9.7	10.1	9.9
Industrial/Machinery	1.5	1.1	1.3	1.1	1.1
Adhesives, Inks & Coatings	8.2	8.3	7.2	6.8	7.0
All Other	8.8	8.4	8.9	8.6	8.8
Exports	6.9	7.4	8.8	10.4	9.3
Total	100.0%	100.0%	100.0%	100.0%	100.0%

*Note: All figures exclude polyurethane

SUMMARY

These Major Market data demonstrate the important relationship between the plastics industry and the general economy. The factors affecting each are common to both: consumer buying attitudes; balance of trade; value of the dollar (inflation); the energy situation; the role of Government regulations; and the desire to increase productivity.

Advances in technology through combinations of plastics, and the use of additives and reinforcements have made plastics important basic raw materials. Plastics consumption continues to grow with consumer acceptance of plastics products not only as replacements for other materials but also where new markets are created through plastics' unique properties and versatility. The concept of plastics as basic materials has opened a new era for the industry.

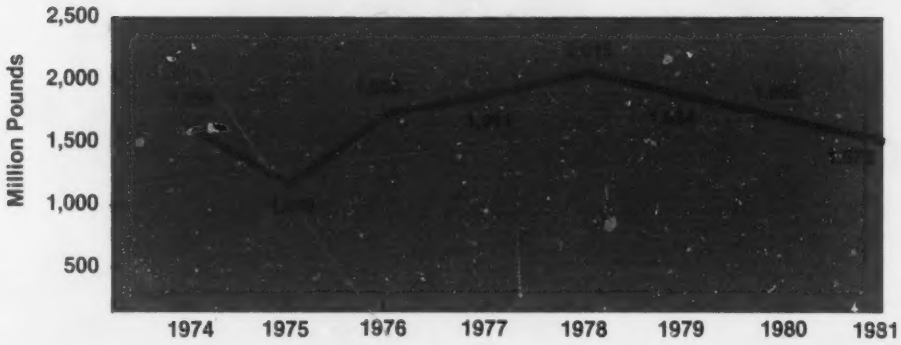
PERCENTAGE CHANGE IN SALES AND USE BY MAJOR MARKET

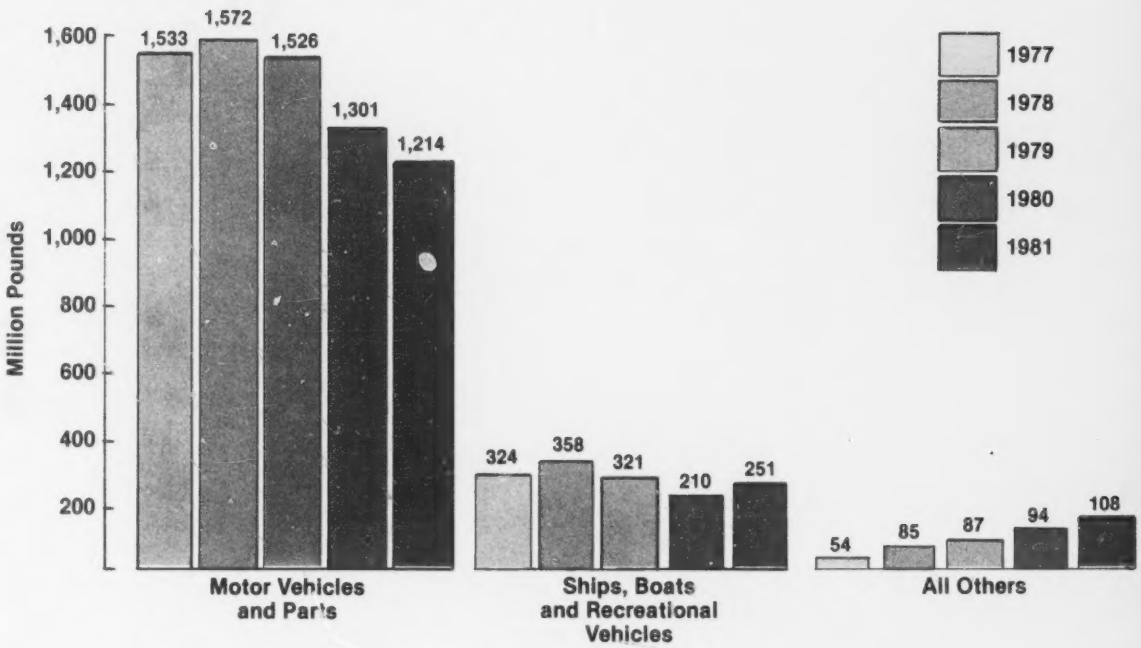
Major Market	% Change 1981/1980	% Change 1980/1979	Growth Rate 1976-1981
Transportation	– 2.0%	–17.0%	– 2.7%
Packaging	4.6	– 3.2	7.3
Building/Construction	13.0	15.2	9.8
Electrical/Electronic	8.8	–19.4	1.1
Furniture/Furnishings	1.5	–13.1	0.7
Consumer/Institutional	3.3	– 5.3	5.5
Industrial/Machinery	0.5	–24.4	4.3
Adhesives/Inks/Coatings	7.8	–14.6	– 2.0
All Other	6.7	–11.3	8.6
Exports	– 6.7	6.9	9.6
Total	5.0%	– 9.1%	6.0%

ANALYSIS BY MAJOR MARKET

Note: Because of non-comparable "line-item" data, polyurethane foam is not included in the tables and graphs of this section. However, polyurethane foam consumption data by major market is provided in Appendix B.

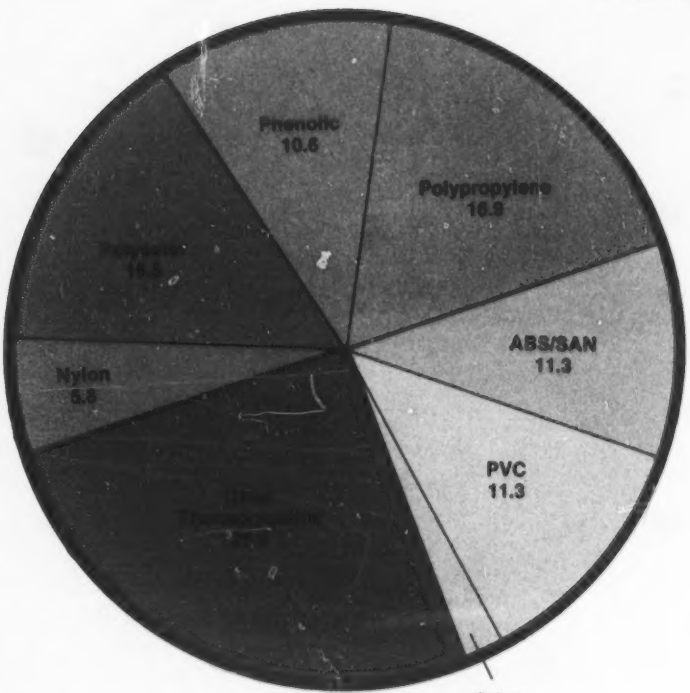
TRANSPORTATION





TRANSPORTATION (cont'd).

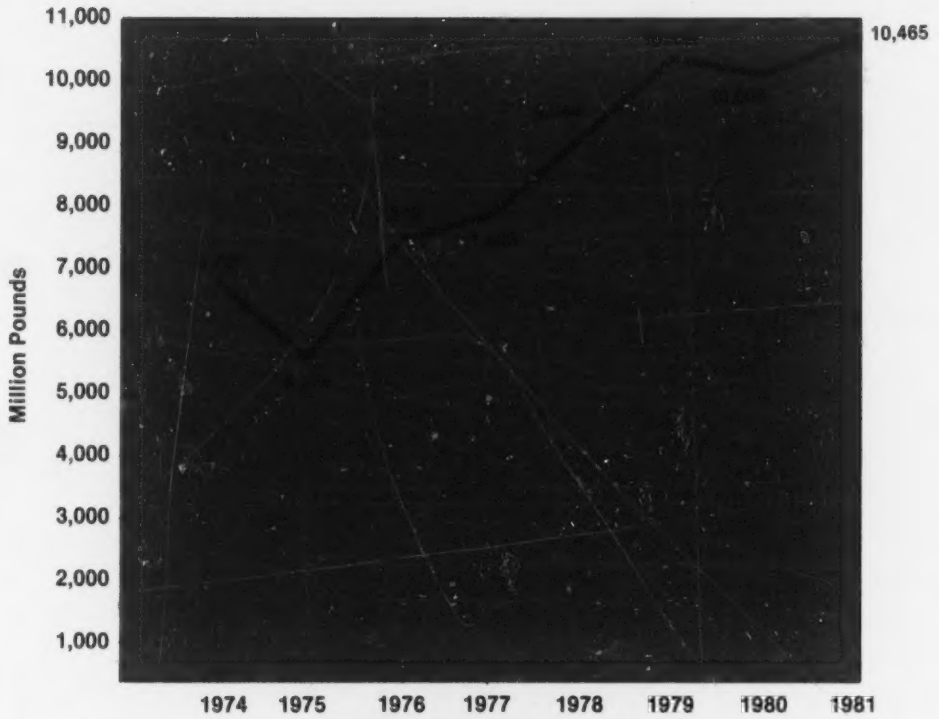
Total Thermosets
28.8%
454 million pounds

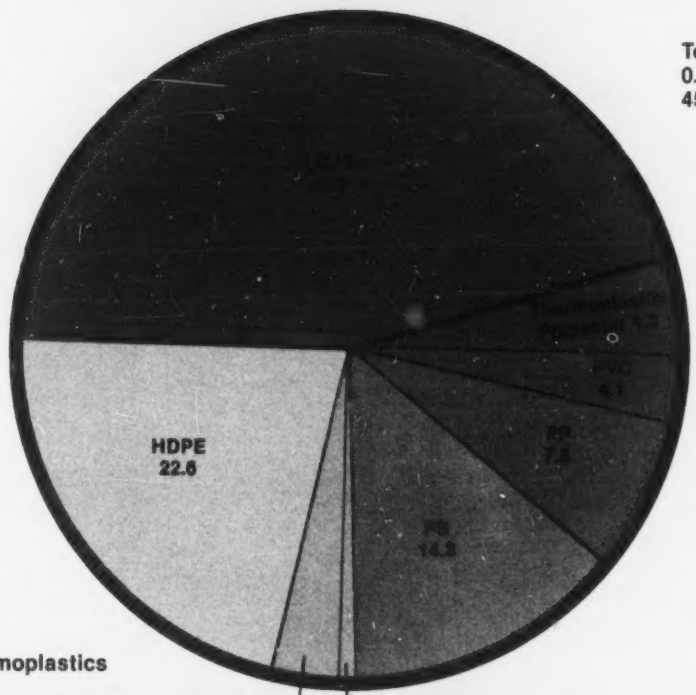


Other
Thermosets
1.7

Total Thermoplastics
71.2%
1,119 million pounds

PACKAGING





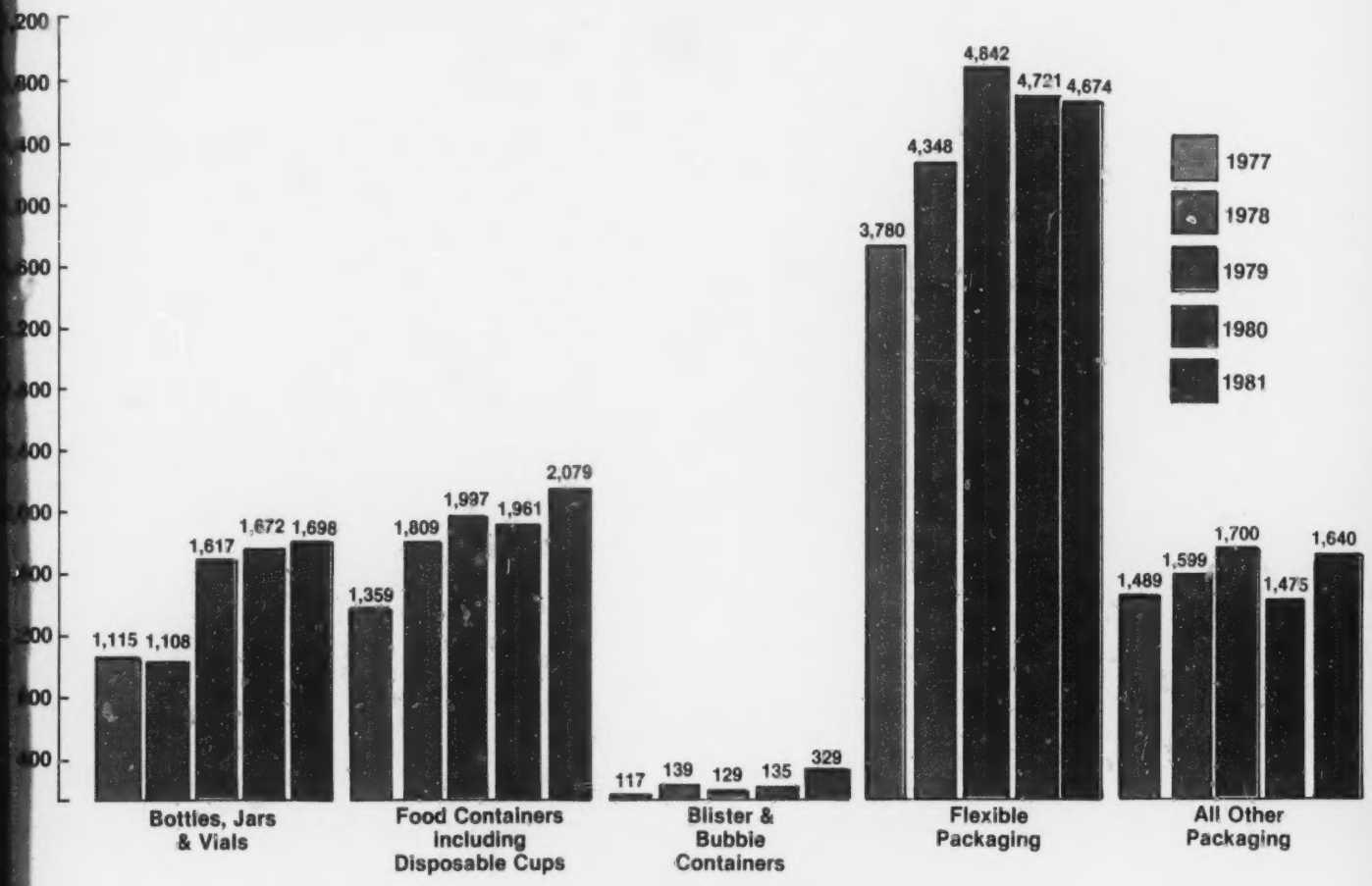
Total Thermosets
0.3%
45 million pounds

Total Thermoplastics
99.7%
10,420 million pounds

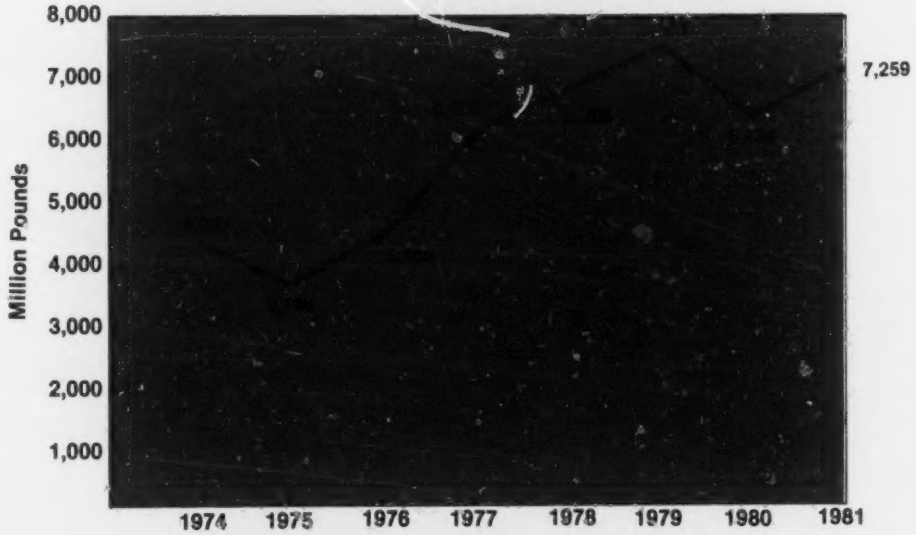
Other
Thermoplastics
2.6

Thermosets
0.3

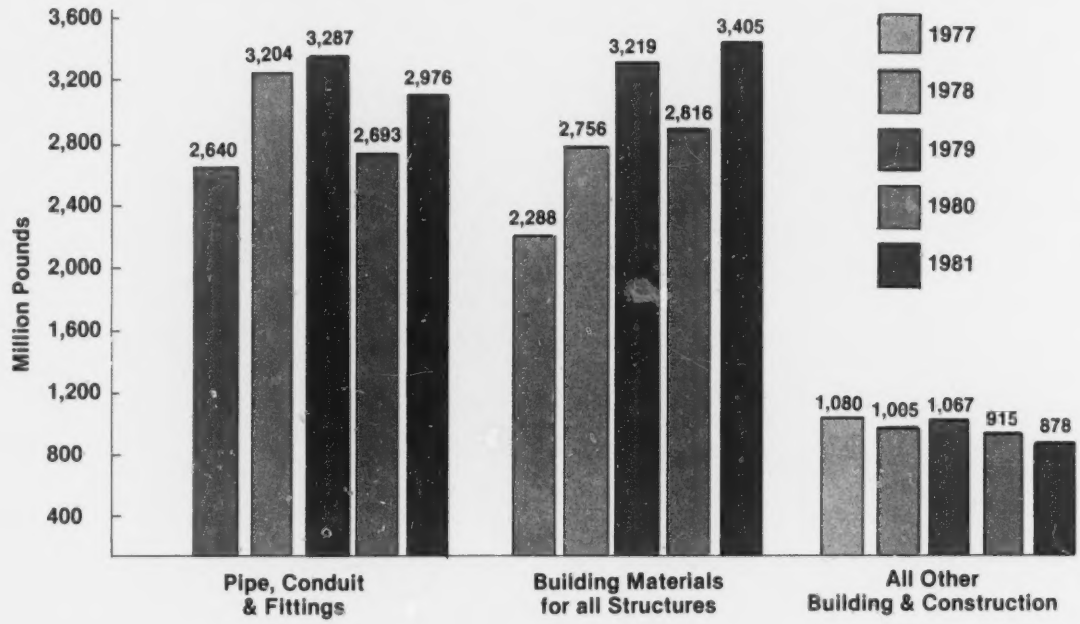
PACKAGING — THERMOPLASTIC DISTRIBUTION

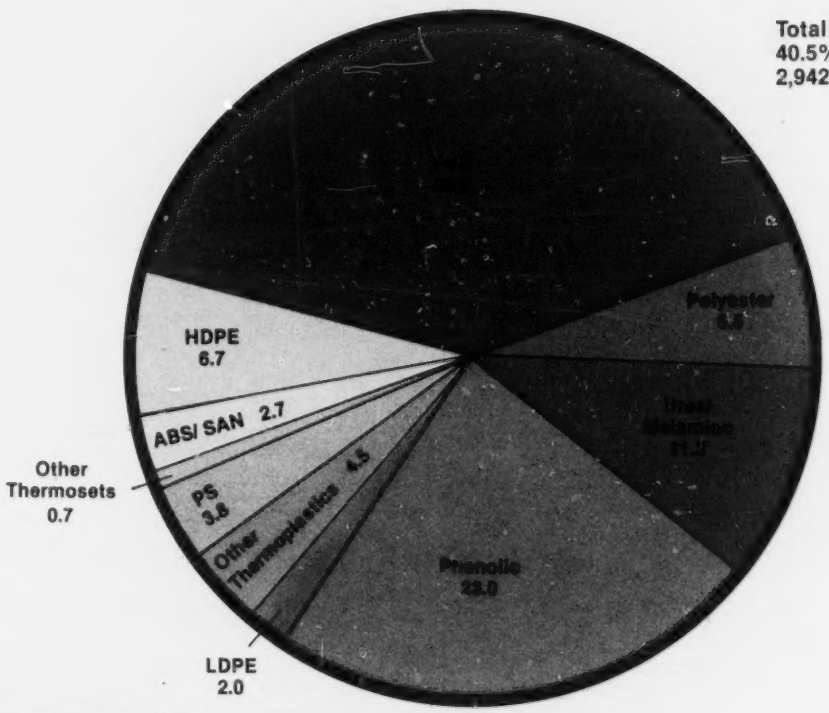


BUILDING AND CONSTRUCTION



BUILDING AND CONSTRUCTION (cont'd.)

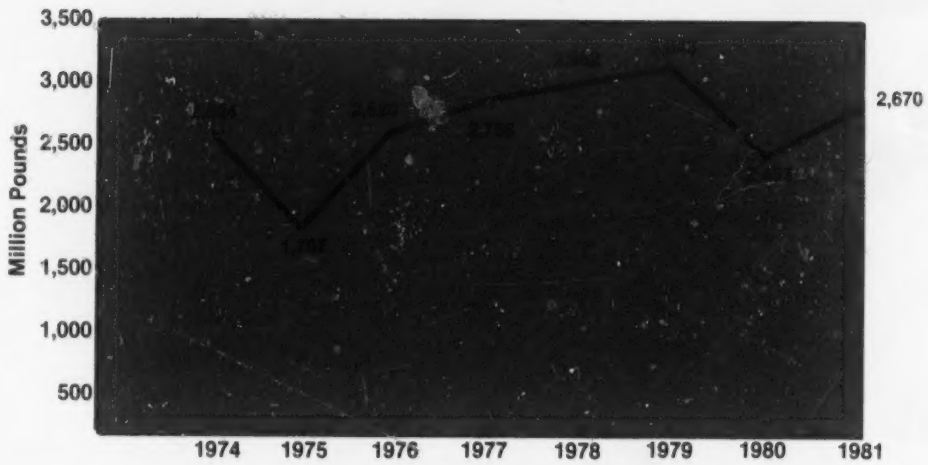


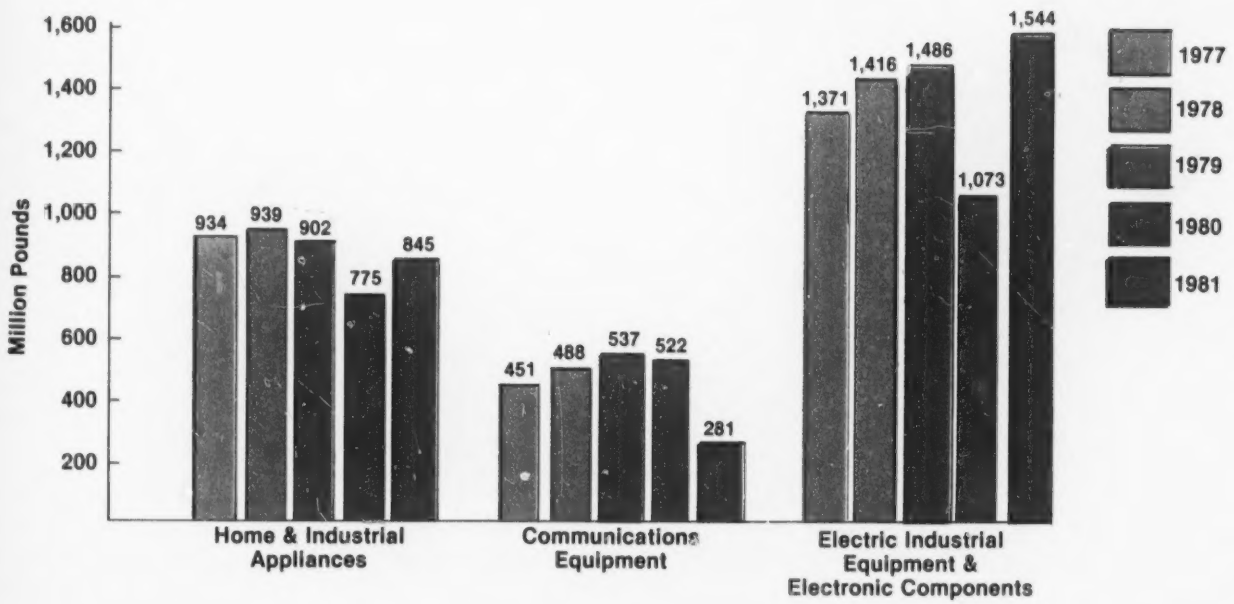


Total Thermosets
40.5%
2,942 million pounds

Total Thermoplastics
59.5%
4,317 million pounds

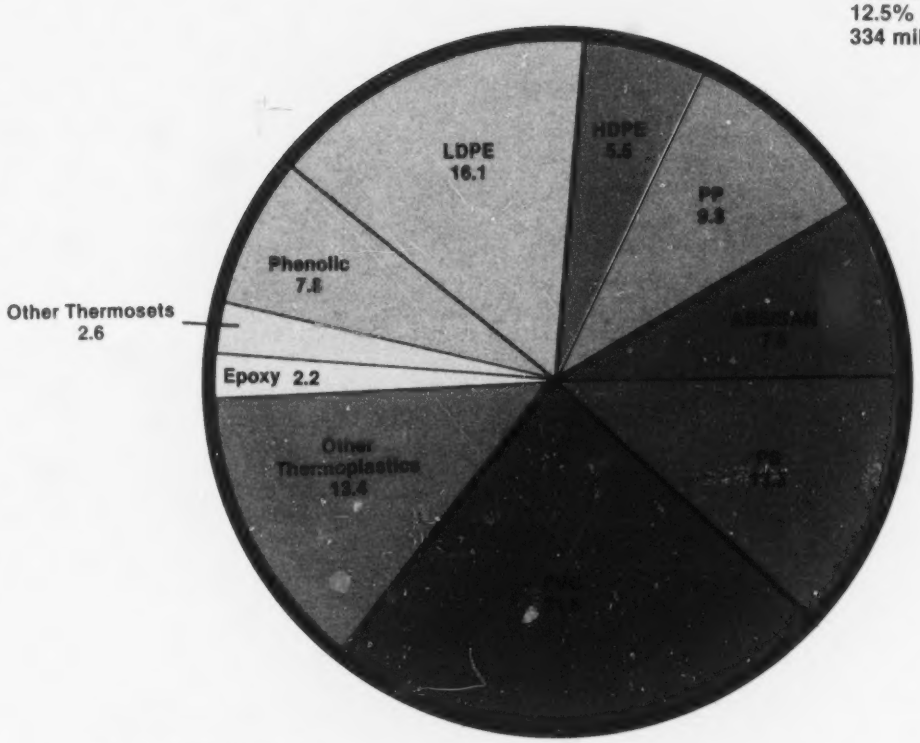
ELECTRICAL AND ELECTRONIC





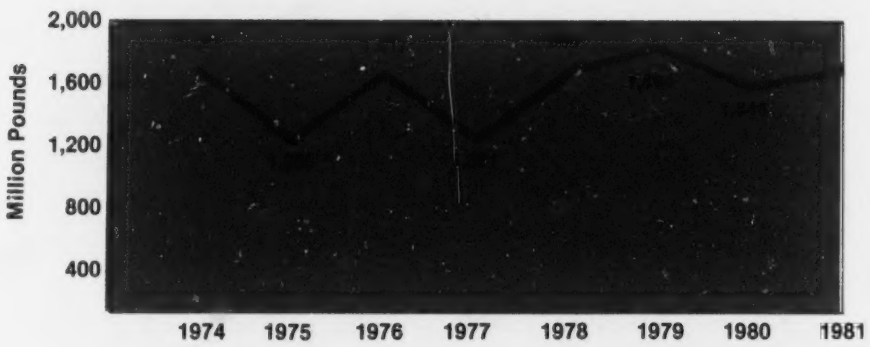
ELECTRICAL AND ELECTRONIC (cont'd.)

Total Thermosets
12.5%
334 million pounds

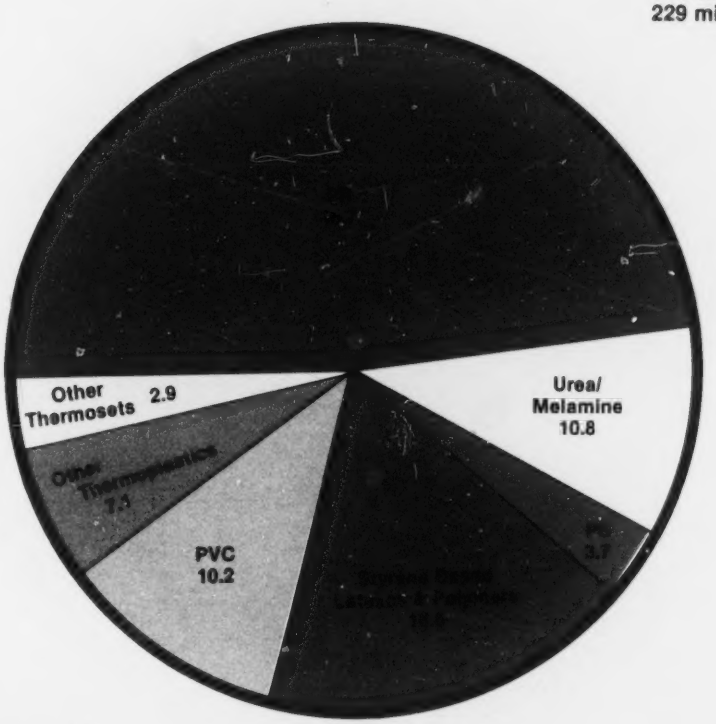


Total Thermoplastics
87.5%
2,336 million pounds

FURNITURE AND FURNISHINGS

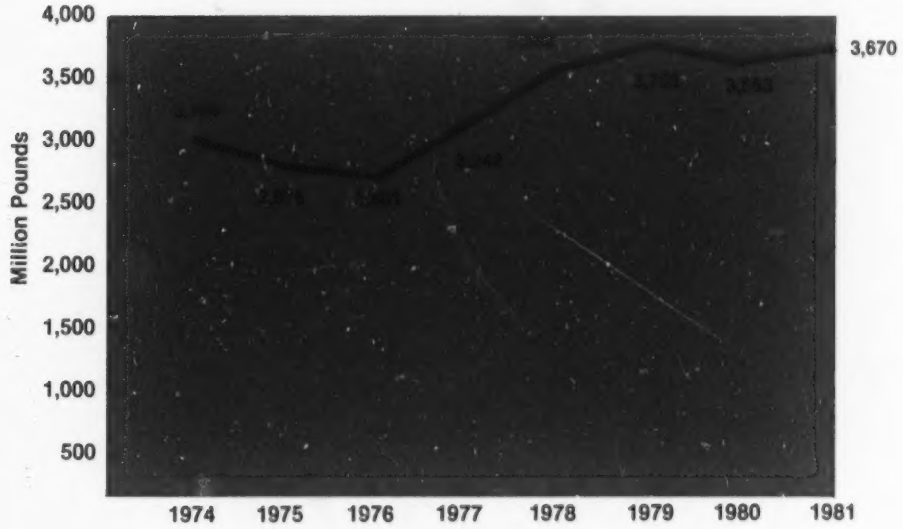


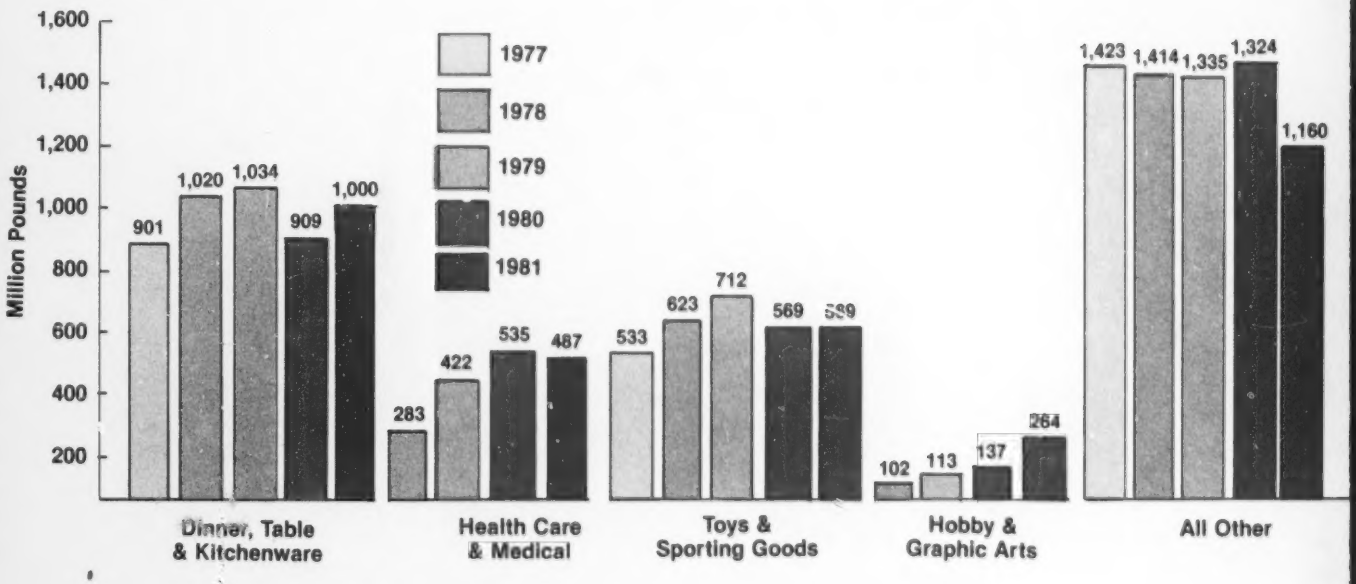
Total Thermosets
13.7%
229 million pounds



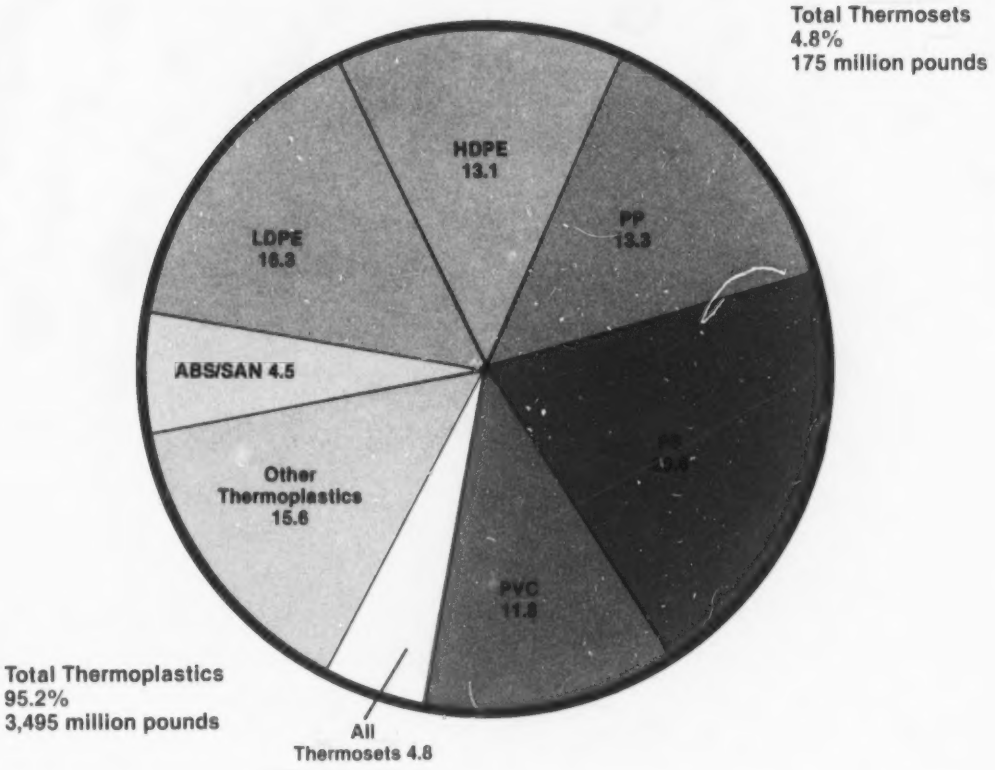
Total Thermoplastics
86.3%
1,441 million pounds

CONSUMER AND INSTITUTIONAL

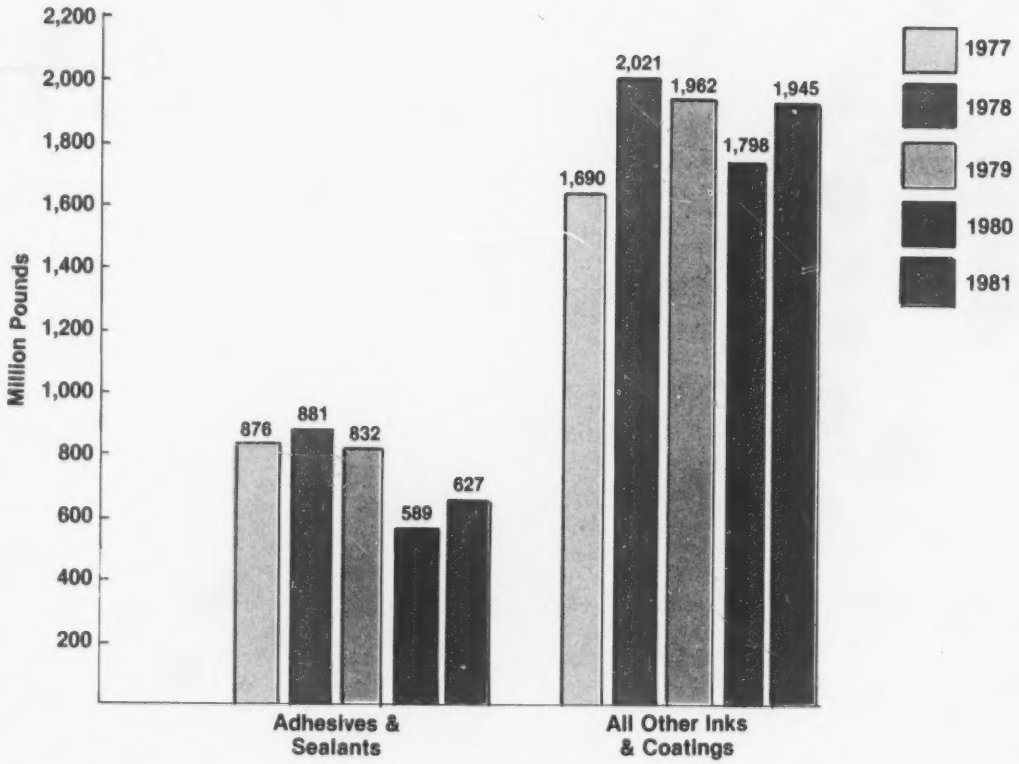




CONSUMER AND INSTITUTIONAL (cont'd.)

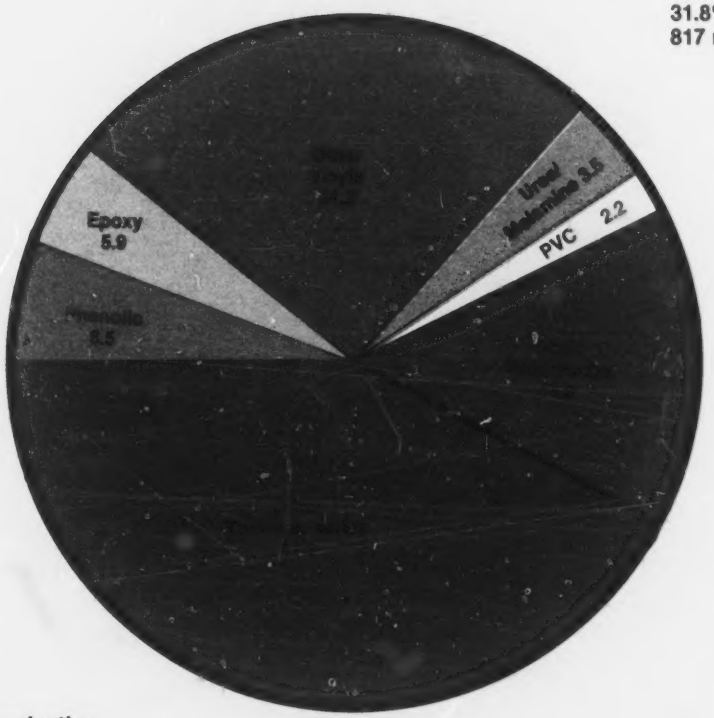


ADHESIVES/INKS/COATINGS



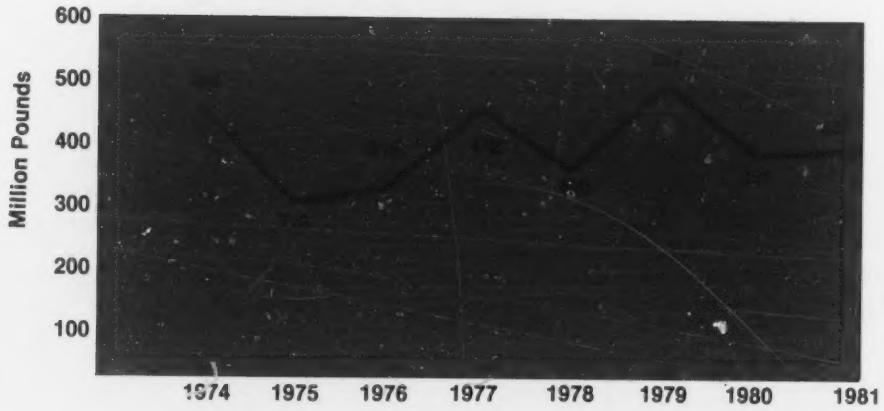
ADHESIVES/INKS/COATINGS (cont'd.)

Total Thermosets
31.8%
817 million pounds

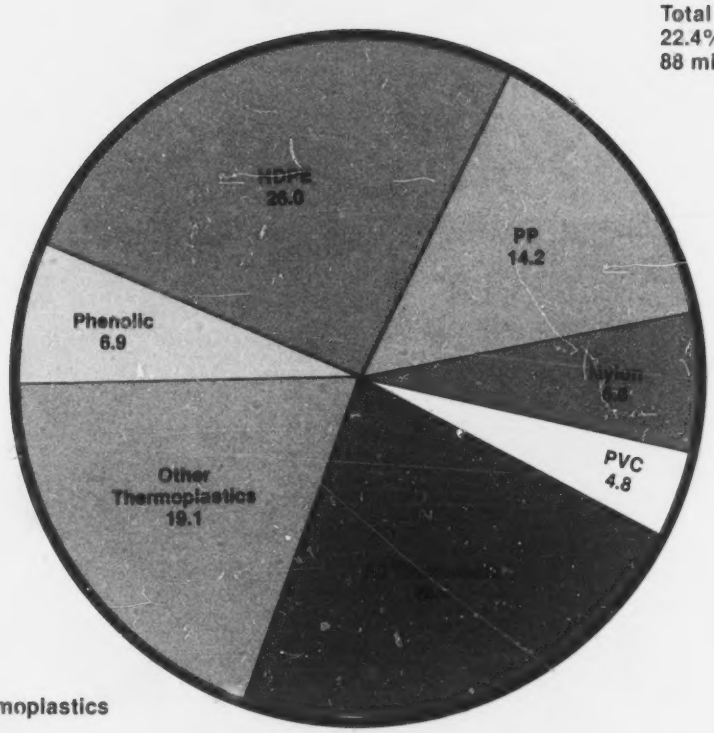


Total Thermoplastics
68.2%
1,755 million pounds

INDUSTRIAL/MACHINERY



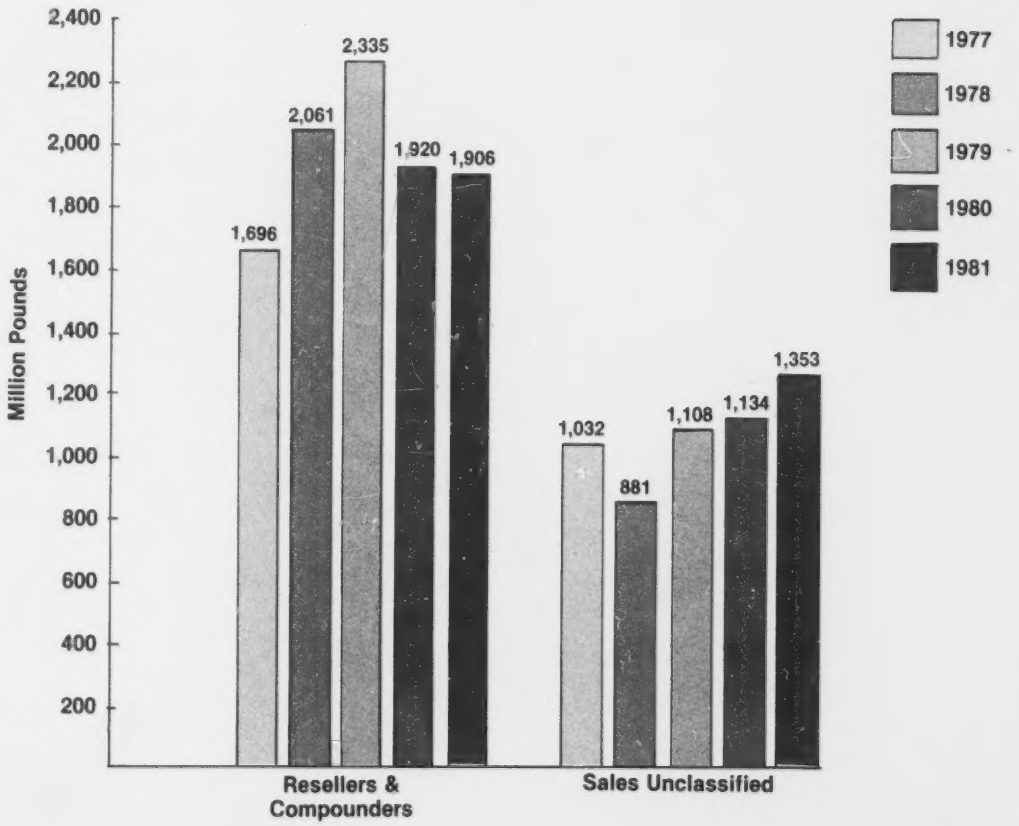
Total Thermosets
22.4%
88 million pounds



Total Thermoplastics
77.6%
305 million pounds

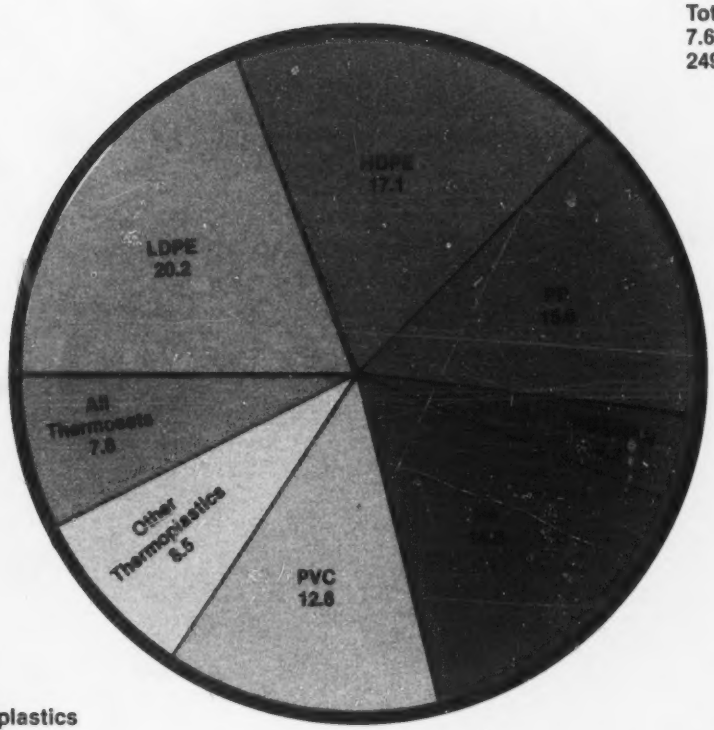
ALL OTHER

Million Pounds
3,500
3,000
2,500
2,000
1,500
1,000
500
1974
1975
1976
1977
1978
1979
1980
1981


Million Pounds
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
1,696
2,061
2,335
1,920
1,906
1,032
881
1,108
1,134
1,353
1977
1978
1979
1980
1981
Resellers & Compounders
Sales Unclassified

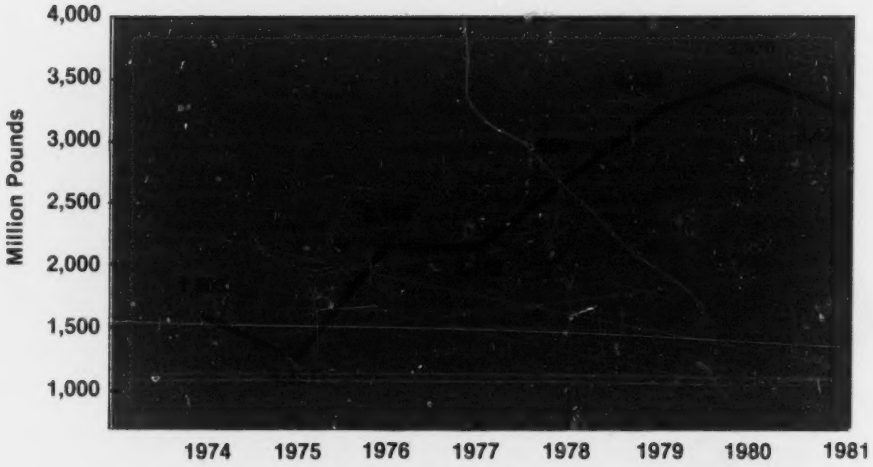
ALL OTHER (cont'd.)

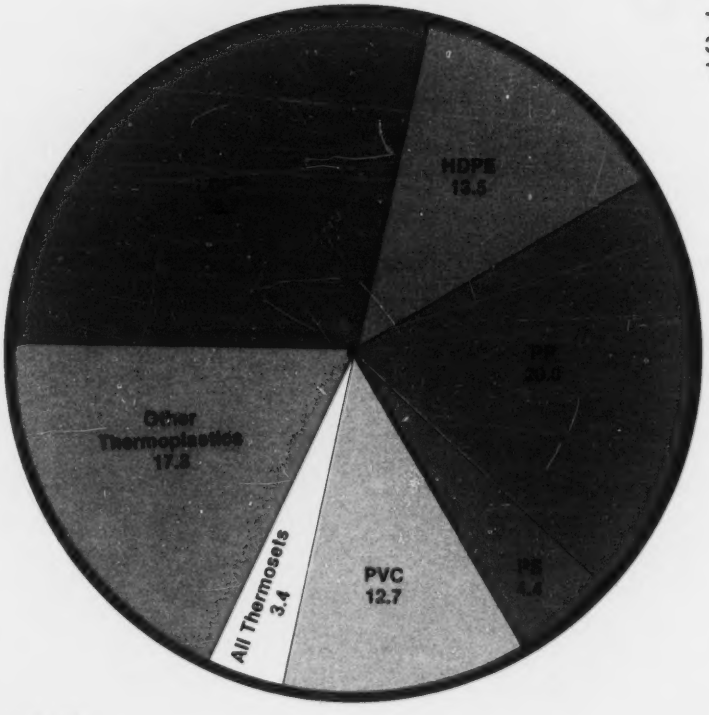
Total Thermosets
7.6%
249 million pounds



Total Thermoplastics
92.4%
3,010 million pounds

EXPORTS





Total Thermosets
3.4%
117 million pounds

Total Thermoplastics
96.6%
3,308 million pounds

APPENDIX A

Table of 1981 distribution of plastics resins sales and use by Major Market, including market segments.

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1981 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	TOTAL THERMOSETS		TOTAL THERMOPLASTICS		GRAND TOTAL (EXCLUDING POLYURETHANE FOAM)		POLYURETHANE FOAM	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	454	8.3	1,119	3.6	1,573	4.3	283	16.2
Motor Vehicles and Parts	198	3.6	1,016	3.2	1,214	3.3		
Ships, Boats and Recreational Vehicles	214	3.9	37	0.1	251	0.7		
All Other Transportation Equipment	42	0.8	66	0.3	108	0.3		
PACKAGING, TOTAL	45	0.8	10,420	33.1	10.465	28.3	77	4.4
Bottles, Jars, Vials			1,698	5.4				
Food Containers Including Disposable Cups			2,079	6.6				
Blister and Bubble Containers			329	1.0				
Flexible Packaging - *(Bags, Liners, Etc.)*			4,674	14.9				
Household and Institutional Refuse Bags & Film			1,972	6.3				
All Other Flexible Packaging			2,702	8.6				
All Other Packaging	32	0.6	1,640	5.2	1,672	4.5		
BUILDING AND CONSTRUCTION, TOTAL	2,942	54.0	4,317	13.7	7,259	19.6	328	18.8
Pipe, Conduit and Fittings	80	1.5	2,896	9.2	2,976	8.0		
Building Materials for All Structures	2,339	42.9	1,066	3.4	3,405	9.2		
Siding	687	12.6	165	0.5	852	2.3		
Flooring	660	12.1	346	1.1	1,005	2.7		
Insulation Materials	381	7.0	218	0.7	599	1.6		
All Other Building Materials for All Structures	611	11.2	337	1.1	949	2.6		
All Other Building and Construction	523	9.6	355	1.1	878	2.4		
ELECTRICAL / ELECTRONIC, TOTAL	334	6.2	2,336	7.4	2,670	7.2	76	4.4
Home and Industrial Appliances	123	2.3	721	2.3	845	2.3		
Communications Equipment	28	0.5	254	0.8	281	0.7		
Electric Industrial Equipment Combined with Electronic Components	183**	3.4**	1,361**	4.3**	1,544**	4.2**		
Storage Batteries								
FURNITURE AND FURNISHINGS, TOTAL	229	4.2	1,441	4.6	1,670	4.5	898	51.5
Rigid Furniture	201	3.7	94	0.3	295	0.8		
Flexible Furniture	1	0.0	33	0.1	34	0.1		
Textiles and Other Furnishings	27	0.5	1,314	4.2	1,341	3.6		
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	175	3.2	3,495	11.1	3,670	9.9		
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.	50	0.9	950	3.0	1,000	2.7		
Health Care and Medical Products					541	1.5		
Toys and Sporting Goods	37	0.7	532	1.7	569	1.5		
Hobby and Graphic Arts Supplies					400	1.1		
All Other Consumer and Institutional Products	77	1.4	1,083	3.5	1,160	3.1		
INDUSTRIAL / MACHINERY, TOTAL	88	1.6	305	0.9	393	1.1		
ADHESIVES / INKS / COATINGS, TOTAL	817	15.0	1,755	5.6	2,572	7.0		
Adhesives and Sealants	149	2.7	478	1.5	627	1.7		
All Other Inks and Coatings	668	12.3	1,277	4.1	1,945	5.3		
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	249	4.6	3,010	9.5	3,259	8.8	82	4.7
Resellers and Compounders	65	1.2	1,840	5.8	1,906	5.2		
Sales Unclassified	184	3.4	1,170	3.7	1,353	3.6		
EXPORTS, TOTAL	117	2.1	3,308	10.5	3,425	9.3		
GRAND TOTAL	5,450	100.0	31,506	100.0	36,956	100.0	1,744	100.0

** = Includes Storage Batteries

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

Release Date: May 24, 1982

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1981 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	EPOXY		POLYESTER		UREA & MELAMINE		PHENOLICS		ALL OTHER THERMOSETS	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	259	26.5	D	D	167	7.0	D	D
Motor Vehicles and Parts			68	7.0			126	5.3		
Ships, Boats and Recreational Vehicles			176	18.0						
All Other Transportation Equipment			15	1.5						
PACKAGING, TOTAL	D	D	D	D	D	D	D	D	-	-
Bottles, Jars, Vials										
Food Containers Including Disposable Cups										
Blister and Bubble Containers										
Flexible Packaging - (*Bags, Liners, Etc.*)										
Household and Institutional Refuse Bags & Film										
All Other Flexible Packaging										
All Other Packaging										
BUILDING AND CONSTRUCTION, TOTAL	49	14.8	401	41.0	820	62.4	1,672	70.4	-	-
Pipe, Conduit and Fittings			50	5.1			12	0.5		
Building Materials for All Structures	12	3.6	151	15.5	589	44.8	1,587	66.8		
Siding							471	19.8		
Flooring							424	17.9		
Insulation Materials							377	15.9		
All Other Building Materials for All Structures							315	13.2		
All Other Building and Construction			200	20.5			73	3.1		
ELECTRICAL/ELECTRONIC, TOTAL	58	17.5	33	3.4	D	D	209	8.8	D	D
Home and Industrial Appliances			7	0.7			106	4.5		
Communications Equipment			3	0.3			19	0.8		
Electric Industrial Equipment Combined with Electronic Components			23**	2.4**			84**	3.5**		
Storage Batteries										
FURNITURE AND FURNISHINGS, TOTAL	-	-	23	2.4	181	13.8	25	1.1	-	-
Rigid Furniture					165	12.6	25	1.1		
Flexible Furniture										
Textiles and Other Furnishings										
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	D	D	94	9.6	48	3.7	D	D	D	D
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.										
Health Care and Medical Products										
Toys and Sporting Goods			37	3.8						
Hobby and Graphic Arts Supplies			8	0.8						
All Other Consumer and Institutional Products			46	4.7						
INDUSTRIAL/MACHINERY, TOTAL	D	D	D	D	-	-	27	1.1	-	-
ADHESIVES/INKS/COATINGS, TOTAL	151	45.5	9	0.9	90	6.8	166	7.0	401	88.7
Adhesives and Sealants	22	6.6	4	0.4	3	0.2	120	5.1	-	-
All Other Inks and Coatings	129	38.9	5	0.5	87	6.6	46	1.9	401	88.7
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	26	7.8	87	8.9	87	6.6	49	2.1	-	-
Resellers and Compounders			26	2.7			10	0.4		
Sales Unclassified			61	6.2			39	1.7		
EXPORTS, TOTAL	41	12.3	11	1.1	24	1.8	20	0.8	21	4.6
GRAND TOTAL	332	100.0	977	100.0	1,314	100.0	2,375	100.0	452	100.0

Note: Table does not add vertically or horizontally due to disclosures.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

** = Includes Storage Batteries.
D = Disclosure

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1981 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	LOW DENSITY POLYETHYLENE		HIGH DENSITY POLYETHYLENE		POLYPROPYLENE		ABS & SAN		POLYSTYRENE		SBL OSBL & OSBP	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	53	0.7	63	1.3	266	6.8	177	17.6	16	0.4	D	D
Motor Vehicles and Parts			55	1.2	245	6.3	167	16.6				
Ships, Boats and Recreational Vehicles							8	0.8				
All Other Transportation Equipment							2	0.2				
PACKAGING, TOTAL	4,602	61.2	2,367	50.5	812	20.9	29	2.9	1,494	41.5	D	D
Bottles, Jars, Vials	81	1.1	946	20.2	80	2.1			106	2.9		
Food Containers Including Disposable Cups	392	5.2	652	13.9	33	0.8			906	25.1		
Blister and Bubble Containers							-	-				
Flexible Packaging - (*Bags, Liners, Etc.*)	3,640	48.4	256	5.5	316	8.2	-	-	94	2.6		
Household and Institutional Refuse Bags & Film	1,617	21.5	75	1.6	84	2.2	-	-	-			
All Other Flexible Packaging	2,023	26.9	181	3.9	232	6.0	-	-	94	2.6		
All Other Packaging												
BUILDING AND CONSTRUCTION, TOTAL	148	2.0	486	10.4	D	D	194	19.3	273	7.6	2	0.2
Pipe, Conduit and Fittings	35	0.5	444	9.5			179	17.8				
Building Materials for All Structures	48	0.6							250	7.0		
Siding									-	-		
Flooring									-	-		
Insulation Materials									215	6.0		
All Other Building Materials for All Structures									35	1.0		
All Other Building and Construction	65	0.9										
ELECTRICAL / ELECTRONIC, TOTAL	431	5.7	146	3.1	248	6.4	209	20.8	360	10.0	D	D
Home and Industrial Appliances					97	2.5	167		259	7.2		
Communications Equipment			37	0.8								
Electric Industrial Equipment Combined with Electronic Components	366	4.9										
Storage Batteries	-	-										
FURNITURE AND FURNISHINGS, TOTAL	15	0.2	D	D	813	20.9	D	D	62	1.7	277	34.5
Rigid Furniture									40	1.1	-	
Flexible Furniture												
Textiles and Other Furnishings					794	20.4						
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	598	8.0	482	10.3	487	12.5	165	16.4	756	21.0	9	1.1
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.	157	2.1	184	3.9	160	4.1	48	4.8	314	8.7		
Health Care and Medical Products	133	1.8	29	0.6	180	4.6	16	1.6	100	2.8		
Toys and Sporting Goods	69	0.9	109	2.3	40	1.0	27	2.7	202	5.6		
Hobby and Graphic Arts Supplies					12	0.3	11	1.1	78	2.2		
All Other Consumer and Institutional Products					95	2.5	63	6.2	61	1.7		
INDUSTRIAL / MACHINERY, TOTAL	D	D	102	2.2	56	1.4	D	D	D	D	D	D
ADHESIVES / INKS / COATINGS, TOTAL	D	D	D	D	D	D	-	-	D	D	D	D
Adhesives and Sealants												
All Other Inks and Coatings												
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	658	8.8	557	11.9	488	12.6	137	13.7	482	13.4	92	11.4
Resellers and Compounders	402	5.4	376	8.0	403	10.4	73	7.3	254	7.1		
Sales Unclassified	256	3.4	181	3.9	85	2.2	64	6.4	228	6.3		
EXPORTS, TOTAL	984	13.1	461	9.8	685	17.6	66	6.6	150	4.2	60	7.5
GRAND TOTAL	7,516	100.0	4,683	100.0	3,888	100.0	1,005	100.0	3,604	100.0	804	100.0

Note: Table does not add ventically or horizontally due to disclosure. D = Disclosure.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1981 DISTRIBUTION OF PLASTIC RESIN SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	NYLON		POLYVINYL CHLORIDE		PVAc, PVA & OTHER VINYL RESINS		THERMOPLASTIC POLYESTER		ALL OTHER THERMOPLASTICS	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	92	31.9	177	3.2	D	D	23	4.0	185	7.2
Motor Vehicles and Parts			165	2.9					179	7.0
Ships, Boats and Recreational Vehicles										
All Other Transportation Equipment										
PACKAGING, TOTAL	32	11.1	424	7.6	D	D	446	76.8	119	4.7
Bottles, Jars, Vials			97	1.7			371	63.9	15	0.6
Food Containers Including Disposable Cups			19	0.4					12	0.5
Blister and Bubble Containers			79	1.4					66	2.6
Flexible Packaging - (*Bags, Liners, Etc.*)			214	3.8						
Household and Institutional Refuse Bags & Film			167	3.0						
All Other Flexible Packaging			47	0.8						
All Other Packaging	5	1.7	15	0.3						
BUILDING AND CONSTRUCTION, TOTAL	D	D	2,891	51.6	22	2.3	D	D	270	10.5
Pipe, Conduit and Fittings			2,205	39.4					20	0.8
Building Materials for All Structures			523	9.3					212	8.3
Siding			159	2.8						
Flooring			284	5.1						
Insulation Materials									146	5.7
All Other Building Materials for All Structures									38	1.4
All Other Building and Construction			163	2.9						
ELECTRICAL / ELECTRONIC, TOTAL	57	19.7	583	10.4	D	D	34	5.9	262	10.2
Home and Industrial Appliances	11	3.8	33	0.6					98	3.8
Communications Equipment	7	2.4	95	1.7			25	4.3		
Electric Industrial Equipment Combined with Electronic Components	39**	13.5**	455**	8.1**						
Storage Batteries										
FURNITURE AND FURNISHINGS, TOTAL	8	2.8	171	3.1	41	4.2	D	D	24	0.9
Rigid Furniture	–	–	8	0.1						
Flexible Furniture			20	0.4						
Textiles and Other Furnishings			143	2.6						
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	17	5.9	434	7.7	76	7.8	11	1.9	460	18.0
Dinner, Table & Kitchenware, Picnic Jugs, Ice Chests, Etc.	5	1.7	42	0.7					39	1.5
Health Care and Medical Products	3	1.0	78	1.4						
Toys and Sporting Goods									266	10.4
Hobby and Graphic Arts Supplies	7	2.4	308	5.5					140	5.5
All Other Consumer and Institutional Products	26	9.0	19	0.3			D	D	31	1.2
INDUSTRIAL / MACHINERY, TOTAL	D	D	56	1.0	622	63.8	D	D	736	28.7
ADHESIVES / INKS / COATINGS, TOTAL			22	0.4	287	29.4			120	4.7
Adhesives and Sealants			34	0.6	335	34.4			616	24.0
All Other Inks and Coatings										
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	31	10.8	410	7.3	D	D	D	D	142	5.6
Resellers and Compounders	25	8.7	204	3.6						
Sales Unclassified	6	2.1	206	3.7						
EXPORTS, TOTAL	19	6.6	436	7.8	73	7.5	42	7.2	332	13.0
GRAND TOTAL	288	100.0	5,601	100.0	975	100.0	581	100.0	2,561	100.0

Note: Table does not add vertically or horizontally due to disclosure

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

** = Includes storage batteries.
D = Disclosure

APPENDIX B

DISTRIBUTION OF POLYURETHANE FOAM SALES AND USE BY MAJOR MARKET

(in millions of pounds)

	Quantity					% of Total				
	1977	1978	1979	1980	1981	1977	1978	1979	1980	1981
Transportation	457	466	418	288	268	24.6%	23.8%	21.7%	16.8%	15.4%
Flexible	383	390	367	242	227	20.6	19.9	19.0	14.1	13.0
Rigid	74	76	51	46	41	4.0	3.9	2.7	2.7	2.4
Packaging	49	57	62	57	77	2.6	2.9	3.2	3.3	4.4
Flexible	28	33	31	23	35	1.5	1.7	1.6	1.3	2.0
Rigid	21	24	31	34	42	1.1	1.2	1.6	2.0	2.4
Furniture/Furnishings	951	980	973	872	898	51.2	50.0	50.4	50.9	51.5
Flexible	919	947	948	850	882	49.5	48.3	49.1	49.7	50.6
Rigid	32	33	25	22	16	1.7	1.7	1.3	1.2	0.9
Building/Construction	236	283	322	315	328	12.7	14.4	16.7	18.4	18.8
Electrical/Electronic	81	79	84	69	76	4.4	4.0	4.4	4.1	4.4
All Other	83	96	71	111	97	4.5	4.9	3.6	6.5	5.5
Total	1,857	1,961	1,930	1,712	1,744	100.0%	100.0%	100.0%	100.0%	100.0%

PROCESSING & MACHINERY

PROCESSING METHODS

INJECTION MOLDING

Injection molding is the principal method of forming thermoplastic materials. Modifications of the injection process are sometimes used for thermosetting plastics.

In injection molding, plastic material is put into a hopper which feeds into a heating chamber. A plunger pushes the plastic through this long heating chamber where the material is softened to a fluid state. At the end of this chamber there is a nozzle which abuts firmly against an opening into a cool, closed mold. The fluid plastic is forced at high pressure through this nozzle into the cold mold. As soon as the plastic cools to a solid state, the mold opens and the finished plastic is ejected from the press.

The problem with injection molding of thermosetting materials is that, under heat, these plastics will first soften, then harden to an infusible state. Thus it is essential that no softened thermosetting material in the heating chamber be allowed to remain there long enough to set.

Jet molding, offset molding and molding using a screw-type machine overcome this problem by liquefying the thermosetting plastic material just as it goes through the injection nozzle into the mold, but not before.

BLOW MOLDING

Blow molding is a method of forming used with thermoplastic materials.

Basically, blow molding consists of stretching and then hardening a plastic against a mold. There are two general methods of doing this type of thermoplastic molding: the direct method and the indirect method, encompassing several variations of each.

In the direct method, a glob of molten thermoplastic material is formed into the rough shape of the desired finished product. This shape is then inserted in a female mold and air blown into the plastic, as into a balloon, to force it against the sides of the mold. The formed material is then cooled before removal from the mold.

In the indirect method, a thermoplastic sheet or special shape is first heated, then clamped between a die and cover. Air pressure forced between the plastic and the cover forces the material into contact with the die, which has the contour desired in the finished product. The plastic is cooled before removal from contact with the die.

COMPRESSION MOLDING

Compression molding is the most common method of forming thermosetting materials. It is not generally used for thermoplastics.

Compression molding is simply the squeezing of a material into a desired shape by application of heat and pressure to the material in a mold.

Plastic molding powder, mixed with such materials or fillers as woodflour, cellulose and asbestos to strengthen or give other added qualities to the finished product, is put directly into the open mold cavity. The mold is then closed, pressing down on the plastic and causing it to flow throughout the mold. It is while the heated mold is closed that the thermosetting material undergoes a chemical change which permanently hardens it into the shape of the mold. The three compression molding factors—pressure, temperature and time mold is closed—vary with the design of the finished article and the material being molded.

EXTRUSION

Extrusion molding is the method employed to form thermoplastic materials into continuous sheeting, film, tubes, rods, profile shapes, filaments, and to coat wire, cable and cord.

In extrusion, dry plastic material is first loaded into a hopper, then fed into a long heating chamber through which it is moved by the action of a continuously revolving screw. At the end of the heating chamber the molten plastic is forced out through a small opening or die with the shape

desired in the finished product. As the plastic extrusion comes from the die, it is fed onto a conveyor belt where it is cooled, most frequently by blowers or by immersion in water.

In the case of wire and cable coating, the thermoplastic is extruded around a continuing length of wire or cable which, like the plastic, passes through the extruder die. The coated wire is wound on drums after cooling.

In producing wide film or sheeting, the plastic is extruded in the form of a tube. This tube may be split as it comes from the die and then stretched and thinned to the dimensions desired in the finished film.

In a different process, the extruded tubing is inflated as it comes from the die, the degree of inflation of the tubing regulating the thickness of the final film.

THERMOFORMING

Thermoforming of plastic sheet has developed rapidly in recent years. Basically, this process consists of heating thermoplastic sheet to a formable plastic state and then applying air and/or mechanical assists to shape it to the contours of a mold.

Air pressure may range from almost zero to several hundred psi. Up to approximately 14 psi (atmospheric pressure), the pressure is obtained by evacuating the space between the sheet and the mold in order to utilize this atmospheric pressure. This range, known as *vacuum forming,* will give satisfactory reproduction of the mold configuration in the majority of forming applications.

TRANSFER MOLDING

Transfer molding is most generally used for thermosetting plastics.

This method is like compression molding in that the plastic is cured into an infusible state in a mold under heat and pressure. It differs from compression molding in that the plastic is heated to a point of plasticity before it reaches the mold and is forced into a closed mold by means of an hydraulically-operated plunger.

Transfer molding was developed to facilitate the molding of intricate products with small deep holes or numerous metal inserts. The dry molding compound used in compression molding sometimes disturbs the position of the metal inserts and the pins which form the holes. The liquefied plastic material in transfer molding flows around these metal parts without causing them to shift position.

REACTION INJECTION MOLDING

Reaction injection molding (RIM) is a relatively new processing technique that has rapidly taken its place alongside more traditional methods. Unlike liquid casting, the two liquid components, polyols and isocyanates, are mixed in a chamber at relatively low temperatures (75°-140°F) before injection into a closed mold. An exothermic reaction occurs and consequently RIM requires far less energy usage than any other injection molding system.

The three major types of polyurethane RIM systems are rigid structural foam, low-modulus elastomers, and high-modulus elastomers.

Reinforced RIM (R-RIM) consists in the addition of such materials as chopped or milled glass fiber to the polyurethane to enhance stiffness and to increase modulus thus expanding the range of applications.

DOLLAR SALES OF PLASTICS MACHINERY[a]
(in millions of dollars)

Machine Type	1977	1978	1979	1980[r]	1981
Injection Molding	290.1	323.0	352.2	296.7	283.4
Structural Foam	8.5	9.5	10.6	11.7	8.7
Extrusion, single screw	91.6	102.0	195.7	203.5	185.8
Extrusion, multi screw	24.2	28.0	27.3	25.9	23.3
Blow Molding	51.1	81.0	91.0	100.0	77.0
Thermoforming	22.0	22.9	25.0	26.2	28.1
Reaction-Injection Molding	3.9	5.2	5.2	6.7	7.8
Compression	23.2	25.0	27.5	24.2	19.2
Foam Molding	3.0	3.5	15.0	14.8	12.2
Transfer Molding	6.6	7.3	7.8	8.1	5.9
Total	524.2	607.4	757.3	717.8	651.4

SHIPMENTS OF PLASTICS MACHINERY BY TYPE
(in number of units)

Year	Injection	Blow Molding	Transfer	Compression	Foam[c]	Thermo-forming[c]	Extruders (Single screw)	Extruders (Multi screw)	Structural Foam
1977	3,341	154[b]	146	476	111	1,148	1,077	149	34
1978	3,782	360	152	563	120	1,192	1,411	145	48
1979	3,690	425	154	586	207	525	1,500	136	51
1980	2,580	447	143	514	160	515	1,399	116	49
1981	2,385	405	131	466	125	582	1,069	97	34

BLOW MOLDING			REACTION-INJECTION MOLDING/CLAMPS
Year	Domestic	Exports	Domestic & Exports
1977	140[b]	14[b]	80
1978	327	33	72
1979	367	58	97
1980	359	88	155
1981	334	71	143

[a]Includes value of machinery not shown in the tables below.
[b] = Extrusion-blow units only
[c]Data base revised in 1979
r = Revised from 1981 edition.
Source: Domestic and export shipments of injection molding and extruders—The Society of the Plastics Industry supplemented by *Modern Plastics Annual Machinery Sales Survey.* All other figures *Modern Plastics.*

STRUCTURAL FOAM		
Year	Domestic	Exports
1977	34	—
1978	48	—
1979	47	4
1980	43	6
1981	31	3

THERMOSET TRANSFER & INJECTION-TRANSFER MOLDING		
Year	Domestic	Exports
1977	127	19
1978	131	21
1979	140	14
1980	124	19
1981	107	24

THERMOFORMING[c]	
Domestic	Exports
1,004	144
1,053	139
464	61
434	81
512	70

FOAM MOLDING[c] (EXPANDED BEAD)		
Year	Domestic	Exports
1977	99	12
1978	106	14
1979	180	27
1980	131	29
1981	93	32

COMPRESSION MOLDING	
Domestic	Exports
443	33
538	25
553	23
487	27
441	25

[c]Data base revised in 1979
Source: *Modern Plastics*

GLOSSARY

GLOSSARY OF SELECTED PLASTICS PROPERTIES

ABLATION — The degradation and decomposition of a material caused by high heat friction.

ABRASION RESISTANCE — Ability to resist surface wear.

AGING — The effect, on materials, of exposure to an environment for an interval of time.

ARC RESISTANCE — The total time in seconds that an intermittent arc may play across a plastic surface without rendering the surface conductive.

BLEEDING — The diffusion of color out of a plastic part into the surrounding surface of part.

BLOCKING — The adhesion between touching layers of plastic, such as that which may develop under pressure during storage or use.

BLOOM — A visible exudation or efflorescence on the surface of a plastic; bloom can be caused by lubricant, plasticizer, etc.

BRITTLE POINT — The highest temperature at which an elastomer fractures in a prescribed impact test procedure.

BRITTLE TEMPERATURE — The lowest temperature at which a plastic material withstands given conditions without failure.

BUCKLING — Crimping of the fibers in a composite material, often occurring in glass-reinforced thermosets due to resin shrinkage during cure.

BULK DENSITY — The density of a molding material in loose form (granular, nodular, etc.) expressed as a ratio of weight to volume.

BULK FACTOR — The ratio of the volume of a molding compound or powdered plastic to the volume of the solid piece produced from it.

COEFFICIENT OF EXPANSION — The fractional change in dimension of a material for a unit change in temperature.

COEFFICIENT OF FRICTION — A measure of the resistance to sliding of one surface in contact with another surface.

COEFFICIENT OF LINEAR EXPANSION — A measure of the change in dimension of an object caused by a change in temperature; specifically measured by the increase in length of an object per unit degree change in temperature.

COEFFICIENT OF THERMAL EXPANSION — The change in volume per unit volume produced by a one degree rise in temperature.

COMPRESSIVE STRENGTH — The ability of a material to resist a force that tends to crush.

CORROSION RESISTANCE — The ability of a material to withstand contact with ambient natural factors or those of a particular artificially created atmosphere.

CRACK — An actual separation of molded material, visible on opposite surfaces of the part, and extending through the thickness; a fracture.

CRAZING — Fine cracks which may extend in a network on or under the surface of a plastic material.

CREEP — The change in dimension of a plastic under load over a period of time, not including the initial instantaneous elastic deformation.

CROSS-LINKING — Applied to polymer molecules, the setting-up of chemical links between the molecular chains. When extensive, as in most thermosetting resins, cross-linking makes one infusible supermolecule of all the chains.

DEFLECTION TEMPERATURE UNDER LOAD — The temperature at which a simple beam has deflected a given amount under load (formerly called heat distortion temperature).

DEFORMATION — Any change of form or shape in a body; the linear change of dimension of a body in a given direction produced by the action of external forces.

DEGRADATION — A deleterious change in the chemical structure of a plastic.

DETERIORATION — A permanent change in the physical properties of a plastic evidenced by impairment of these properties.

DIMENSIONAL STABILITY — Ability of a plastic part to retain the precise shape to which it was molded, cast, or otherwise fabricated.

DISCOLORATION — Any change from an initial color possessed by a plastic; a lack of uniformity in color where color should be uniform over the whole area of a plastic object.

ELASTICITY — That property of plastics materials by virtue of which they tend to recover their original size and shape after deformation.

ELASTOMERIC — The property of a material which at room temperature can be stretched under low stress to at least twice its original length and, upon immediate release of the stress, will return with force to its approximate original length.

ELECTRICAL STRENGTH [DIELECTRIC STRENGTH] — That property of an insulating material which enables it to withstand electric stress; the highest electric stress which an insulating material can withstand for a specified time without the occurrence of electrical breakdown by any path through its bulk.

ELONGATION — Deformation caused by stretching; the fractional increase in length of a material stressed in tension.

ENVIRONMENTAL STRESS CRACKING — The susceptibility of a thermoplastic resin to crack or craze when in the presence of surface active agents or other environments.

EXTENSIBILITY — The ability of a material to extend or elongate upon application of sufficient force, expressed as a percent of the original length.

EXUDATION — The formation in liquid form of a plasticizer on the surface of a plasticized resin.

FADING — Any lightening of an initial color possessed by a plastic; measured by accelerating the process by subjecting the plastic to high intensity ultraviolet rays of approximately the same wave length as those found in sunlight.

FATIGUE — The failure or decay of mechanical properties after repeated applications of stress.

FLAMMABILITY — Measure of the extent to which a material will support combustion.

FLEX LIFE — The time of heat-aging that an insulating material can withstand before failure when bent around a specific radius (used to evaluate thermal endurance).

FLEXURAL STRENGTH — The resistance of a material to being broken by bending stresses.

FLOW MARKS — Wavy surface appearance of an object molded from thermoplastic resins, caused by improper flow of the resin into the mold.

GEL POINT — The stage at which a liquid begins to exhibit pseudoelastic properties. Also known as "gel time."

GLASS TRANSITION TEMPERATURE — The center of the temperature range in which a noncrystalline solid changes from being glass-brittle to being viscous.

GLOSS — Brightness or luster of a plastic resulting from a smooth surface.

HAZE — Cloudy appearance within, or on the surface of, a plastic.

HEAT DISTORTION POINT — The temperature at which a standard test bar deflects under a stated load.

HEAT RESISTANCE — The property or ability of plastics and elastomers to resist the deteriorating effects of elevated temperatures.

HYDROLYSIS — Chemical decomposition of a substance involving the addition of water.

HYDROPHILIC — Capable of absorbing water.

HYDROPHOBIC — Capable of repelling water.

HYDROSCOPIC — Capable of adsorbing and retaining atmospheric moisture.

IMPACT STRENGTH — The ability of a material to withstand shock loading.

LACK OF FILLOUT — An area, occurring usually at the edge of a laminated plastic, where the reinforcement has not been wetted with resin.

MELT INDEX — The amount in grams, of a thermoplastic resin which can be forced through a 0.0825 inch orifice when subjected to 2160 grams force in 10 minutes.

MELTING POINT — The temperature at which a resin changes from a solid to a liquid.

MELT STRENGTH — The strength of a plastic while in the molten state.

MIGRATION — The transfer of a material from a plastic body to other contacting solids.

MOISTURE ABSORPTION — The pick-up of water vapor from air by a material. It relates only to vapor withdrawn from the air by a material and must be distinguished from water absorption, which is the gain in weight due to the take-up of water by immersion.

MOTTLE — The desired or accidental mixture of colors or shades of a color giving more or less distinct or complicated patterns or specks, spots, or streaks of color; any irregular imperfections on the surface.

NECKING — The localized reduction in cross-section which may occur in a material under tensile stress.

OPALESCENCE — The limited clarity of vision through a sheet of transparent plastic at any angle, because of diffusion within or on the surface of the plastic.

OPTICAL DISTORTION — Any apparent alteration of the geometric pattern of an object when seen through a plastic or as a reflection from a plastic surface.

OXIDATION — The chemical reaction involving the process of combining with oxygen to form an oxide; the deterioration of an adhesive film due to atmospheric exposure; the breakdown of a hot melt adhesive due to prolonged heating and oxide formation.

PIT — Small regular or irregular crater in the surface of a plastic, usually with width approximately of the same order of magnitude as its depth.

PLASTICITY — A property of plastics which allows the material to be deformed continuously and permanently without rupture upon the application of a force that exceeds the yield value of the material. (The opposite of "elasticity.").

SHEARING — Breaking caused by the action of equal and opposed forces, located in the same plane.

SPECIFIC GRAVITY — The ratio of the weight of any volume of a substance to the weight of an equal volume of another substance taken as standard at a constant or stated temperature. Solids and liquids are usually compared.

SPECIFIC HEAT — The quantity of heat required to raise the temperature of a unit mass of a substance one (1) degree under specified conditions.

STRESS-CRACK — External or internal cracks in a plastic caused by tensile stresses less than that of its short-time mechanical strength.

SWEATING — Exudation of small drops of liquid, usually a plasticizer or softener, on the surface of a plastic part.

SWELL — A dimensional increase caused by exposure to liquids and/or vapors.

TEAR RESISTANCE — The force required to tear completely across a notched specimen tested according to prescribed procedures, expressed in pounds per inch of specimen thickness.

TENSILE STRENGTH OR STRESS — The maximum tensile load per unit area of original cross section, within the gage boundaries, sustained by the specimen during a tension test.

THERMAL CONDUCTIVITY — Ability of a material to conduct heat.

THERMOELASTICITY — Rubber-like elasticity exhibited by a rigid plastic and resulting from an increase of temperature.

THERMOPLASTICITY — The ability for material to be deformed without breaking with a relatively fast flow, when (at a suitable temperature) this material is properly stressed.

TUNNELING — A condition occurring in incompletely bonded laminates, characterized by release of longitudinal portions of the substrate and deformation of these portions to form tunnel-like structures.

VISCOSITY — The property of resistance to flow exhibited within the body of a material, expressed in terms of relationship between applied shearing stress and resulting rate of strain in shear.

WEATHERING — The exposure of plastics outdoors.

OTHER SOURCES OF PLASTICS INFORMATION

Business Consulting Groups and Publishers

Business Communications Co., Inc.—9 Viaduct Rd., Box 2070C, Stamford, Conn. 06906—203/325-2208

Chem Systems Inc.—303 S. Broadway, Tarrytown, N.Y. 10591—914/631-2828

Eidib Engineering & Research, Inc.—613 Springfield Ave., Berkeley Heights, N.J. 07922—201/464-2244

Frost & Sullivan, Inc.—106 Fulton St., New York, N.Y. 10038—212/233-1080

Hull & Co.—5 Oak St., Greenwich, Conn. 06830—203/622-9120

Charles H. Kline & Co.—330 Passaic Ave., Fairfield, N.J. 07006—201/227-6262

R.M. Kossoff & Associates, Inc.—10 Rockefeller Plaza, New York, N.Y. 10020—212/246-4035

Arthur D. Little, Inc.—35 Acorn Park, Cambridge, Mass. 02140—617/864-5770

Margolis Marketing & Research Co.—232 Madison Ave., Suite 905, New York, N.Y. 10016—212/686-7198

Morton Research Corporation—1745 Merrick Avenue, Merrick, N.Y. 11566—516/378-1066

Noyes Data Corp.—Mill Road at Grand Ave., Park Ridge, N.J. 07656—201/391-8484

Predicasts, Inc.—200 University Circle Research Center, 11001 Cedar Ave., Cleveland, Ohio 44106—216/795-3000

Peter Sherwood Associates, Inc.—60 East 42nd St., New York, N.Y. 10017—212/687-3653

Skeist Laboratories, Inc.—112 Naylon Ave., Livingston, N.J. 07039—201/994-1050

Springborn Laboratories—P.O. Box J, Hazardville Station, Enfield, Conn. 06082—203/749-8371

SRI International—Menlo Park, Cal. 94025—415/326-6200

Technomic Publishing Co.—265 W. State St., Westport, Conn. 06880—203/226-6356

Technomic Research Associates, Inc.—1 North Wacker Drive, Chicago, Ill. 60606—312/346-5901

Roger Williams Technical & Economic Services, Inc.—34 Washington Road, P.O. Box 426, Princeton, N.J. 08540—609/799-1200

Government Publications

Annual Survey of Manufactures—Bureau of the Census

Census of Manufactures—Bureau of the Census

Current Industrial Reports—Bureau of the Census

Foreign Trade Reports: FT 135 (imports), FT 410 (exports)—Bureau of the Census

Guide to Census Bureau Data Files and Special Tabulations—Bureau of the Census

Guide to Foreign Trade Statistics—Bureau of the Census

Mineral Industry Surveys—Bureau of Mines

Producer Price Indexes—Bureau of Labor Statistics

Standard Industrial Classification Manual—Office of Management and Budget

Statistical Abstract of the U.S.—Department of Commerce

Statistical Services of the U.S. Government—Office of Management and Budget

Synthetic Organic Chemicals—International Trade Commission

U.S. Industrial Outlook—Department of Commerce

Newspapers

Chemical Marketing Reporter—100 Church St., New York, N.Y. 10007—212/732-9820

Journal of Commerce—110 Wall St., New York, N.Y. 10005—212/425-1616

Rubber & Plastics News—1 Cascade Plaza, Suite 1302, Akron, Ohio 44308—216/253-2183

Trade Associations & Professional Organizations

American Chemical Society—1155 16th St. N.W., Washington , D.C. 20036—202/872-4600
Chemical Coaters Assn.—Box 241, Wheaton, Ill. 60187—312/668-0949
Chemical Fabrics & Film Assn.—1230 Keith Bldg., Cleveland, OH 44115—216/241-7333
Chemical Manufacturers Assn.—2501 M St. NW, Washington, D.C. 20037—202/887-1100
Chemical Marketing Research Assn.—139 Chestnut Ave., Staten Island, N.Y. 10305—212/727-0550
Chemical Specialties Manufacturers Assn.—1001 Connecticut Ave., NW, Washington, D.C. 20036 —202/872-8110
Composite Can & Tube Institute—1800 M St. NW, Washington, D.C. 20036—202/223-4840
Drug, Chemical & Allied Trades Assn.—42-40 Bell Blvd., Suite 204, Bayside, N.Y. 11361—212/229-8891
Dry Color Manufacturers Assn.—Suite 100, 1117 North 19th St., Arlington, VA 22209—703/525-9483
Flexible Packaging Assn.—1111 19th St., N.W., Washington, D.C. 20036
INDA—1700 Broadway, New York, N.Y. 10019—212/582-8401
International Institute of Synthetic Rubber Producers—2077 S. Gessner Rd., Suite 133, Houston, TX 77077—713/783-7511
National Paint & Coatings Assn.—1500 Rhode Island Ave. NW, Washington, D.C. 20005 —202/462-6272
Polyurethane Manufacturers Assn.—Box 35368, Phoenix, AZ 85069—602/973-7772
Rubber Manufacturers Assn.—1901 Pennsylvania Ave. NW, Washington, D.C. 20006—202/785-2602
Society of Plastic Engineers—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Society of the Plastics Industry-Canada—1262 Don Mills Road, Don Mills, Ontario M3B2W7 —416/449-3444
Synthetic Organic Chemical Manufacturers Assn.—1075 Central Park Ave., Scarsdale, N.Y. 10583 —914/725-1492

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Canadian Plastics—1450 Don Mills Road, Don Mills, Ontario M3B2X7—416/445-6641
Chemical Engineering—1221 Ave. of the Americas, New York, N.Y. 10020—212/997-2464
Chemical & Engineering News—733 Third Ave., New York, N.Y. 10017—212/679-6210
Chemical Week—1221 Ave of the Americas, New York, N.Y. 10020—212/997-2922
Market Search, Inc.—P.O. Box 2886, Toledo, OH 43606
Materials Engineering—Penton Plaza, Cleveland, Ohio 44114—216/696-7000
Modern Packaging—205 East 42nd St., New York, N.Y. 10017—212/573-8107
Modern Plastics—1221 Ave. of the Americas, New York, N.Y. 10020—212/997-1221
Packaging Digest—201 East 42nd St., New York, N.Y. 10017—212/867-9191
Plastics Compounding—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Platics Design Forum—1129 East 17th Ave., Denver CO 80218—303/832-1022
Plastics Design & Processing—700 Peterson Rd., Libertyville, IL 60048—312/362-8711
Plastics Engineering—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Plastics Focus—95 Madison Ave., Room 800, New York, N.Y. 10017—212/679-7902
Plastics Industry News—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Machinery & Equipment—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Technology—633 Third Ave., New York, N.Y. 10017—212/986-4800
Plastics World—221 Columbus Ave., Boston, MA 02116—617/536-7780

MONTHLY STATISTICAL REPORT
on
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This publication is the only source of monthly detailed data on production and sales & use (captive) available. A sample of the report follows on the next page. The following materials are included:

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Urea	SAN	PVC
Melamine	Polystyrene	Polyvinyl Acetate
Phenolic	Styrene Butadiene Latexes	Polyvinyl Alcohol
LD Polyethylene	Other Styrene-based	Other Vinyl Resins
HD Polyethylene	Latexes	Thermoplastic Polyester

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MONTHLY STATISTICAL REPORT
THE SOCIETY OF THE PLASTICS INDUSTRY, INC.
(In thousands of pounds, dry weight basis)

THERMOSETTING RESINS

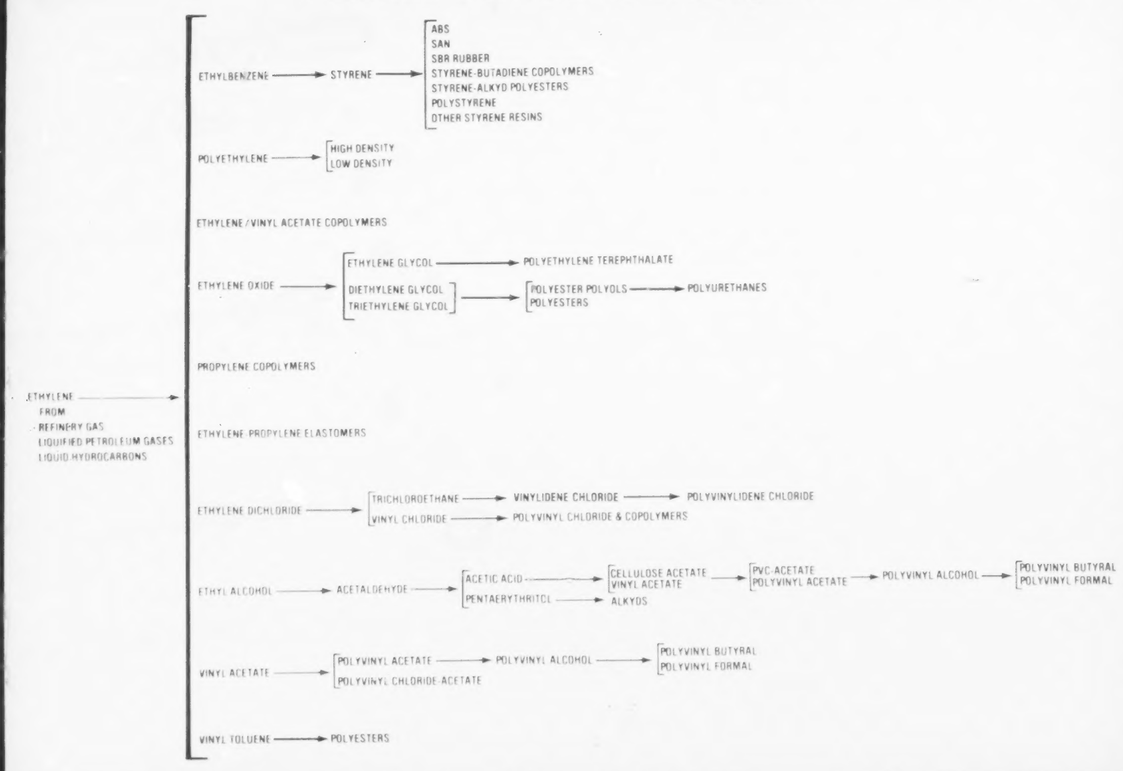
DECEMBER 1980

RESIN KIND & USE	SALES & CAPTIVE USE						PRODUCTION					
	DECEMBER			YEAR-TO-DATE			DECEMBER			YEAR-TO-DATE		
	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change
EPOXY (UNMODIFIED) RESINS, TOTAL	30,709	25,639	+ 19.8	318,756R	331,970	– 4.0	26,491	24,829	+ 6.7	315,039R	361,077	– 12.8
Total Exports	3,732	3,496	+ 6.8	35,547	35,730	– 0.5						
Total Domestic	26,977	22,143	+ 12.8	283,209R	296,240	– 4.4						
Bonding & Adhesives	1,931	1,431	+ 34.9	17,742R	17,454	+ 1.7						
Flooring, Paving & Exposed Aggregate	1,886	1,481	+ 27.3	19,231R	19,583	– 1.8						
Protective Coatings	13,417	9,648	+ 39.1	137,308R	146,137	– 6.0						
Fiber Reinforced Laminates & Composites	5,164	4,785	+ 7.9	62,690R	60,268	+ 4.0						
Tooling, Casting & Molding Resins	2,749	2,417	+ 13.7	25,664R	30,940	– 17.1						
All Other Uses	1,830	2,381	– 23.1	20,574R	21,858	– 5.9						
POLYESTER (UNSATURATED) RESINS, TOTAL	75,749	76,020	– 0.4	921,169R	1,151,581	– 20.0	76,524	78,733	– 2.8	925,947R	1,147,174	– 19.3
General Purpose Resins							66,503	68,719	– 3.2	805,583R	1,010,750	– 20.3
Fire Retardant Resins							2,757	2,550	+ 8.1	28,739	32,035	– 10.3
Chemical Resistant Resins							7,264	7,464	– 2.7	91,625R	104,389	– 12.2
Isophthalic Resins							3,830	4,917	– 22.1	52,437R	63,158	– 17.0
All Other Resins							3,434	2,547	+ 34.8	39,188R	41,231	– 5.0
Total Exports	903	841	+ 7.4	11,254	14,250	– 21.0						
Total Domestic	74,846	75,179	– 0.4	909,915R	1,137,061	– 20.0						
Reinforced Plastics, Total	59,069	58,428	+ 1.1	709,229R	905,949	– 21.7						
Non-Reinforced Plastics, Total	15,777	16,751	– 5.8	200,686R	231,112	– 13.2						
LOW-DENSITY POLYETHYLENE 0.940 & BELOW, TOTAL	719,992	666,312	+ 8.1	7,467,465R	7,814,845	– 4.4	675,113	650,391	+ 3.8	7,290,727R	7,793,223	– 6.4
Total Exports	109,576	65,000	+ 68.6	1,147,442R	897,575	+ 27.8						
Total Domestic	610,416	65,000	+ 68.6	1,147,442R	897,575	+ 27.8						
Film (12 Mils & Below)	610,416	601,312	+ 1.5	6,320,023R	6,917,270	– 8.6						
Sheet (Over 12 Mils)	392,242	383,360	+ 2.3	4,003,749	4,363,250	– 8.2						
Injection Molding	921	1,930	– 52.3	18,176	25,825	– 29.6						
Wire & Cable	46,555	57,100	– 18.5	519,294R	649,975	– 20.1						
Extrusion Coating	20,042	34,572	– 42.0	335,403	424,139	– 20.9						
Blow Molding	44,772	41,001	+ 9.2	517,406R	539,098	– 4.0						
Pipe & Conduit	5,129	4,786	+ 7.2	65,453R	59,524	+ 10.0						
Other Extruded Products	2,660	2,293	+ 16.0	21,768R	32,718	– 33.5						
All Other Uses	4,244	5,140	– 17.4	56,018R	79,614	– 29.6						
HIGH-DENSITY POLYETHYLENE ABOVE 0.940, TOTAL	93,851	71,130	+ 31.9	782,756R	743,127	+ 5.3						
Total Exports	413,377	394,243	+ 4.9	4,393,038R	4,893,243	– 10.2	407,174	419,864	– 3.0	4,405,021	5,009,839	– 12.1
Total Domestic	61,114	54,188	+ 12.8	526,438R	608,654	– 13.5						
Film (12 Mils & Below)	352,263	340,055	+ 3.6	3,866,600	4,284,589	– 9.8						
Sheet (Over 12 Mils)	21,622	14,714	+ 46.9	201,086	212,399	– 5.3						
Injection Molding	7,921	4,541	+ 74.4	54,937	65,520	– 16.2						
Wire & Cable	89,601	84,541	+ 6.0	937,964	1,073,724	– 12.6						
Extrusion Coating	6,285	7,074	– 11.2	105,555	125,921	– 16.2						
Blow Molding	3,213	2,038	+ 57.7	27,565	30,242	– 8.9						
Pipe & Conduit	138,168	139,521	– 1.0	1,573,140	1,724,076	– 8.8						
Other Extruded Products	30,468	25,135	+ 21.2	368,352	400,395	– 8.0						
All Other Uses	1,703	2,120	– 19.7	24,250	18,931	+ 28.1						
	53,282	60,371	– 11.7	573,751	633,381	– 9.4						

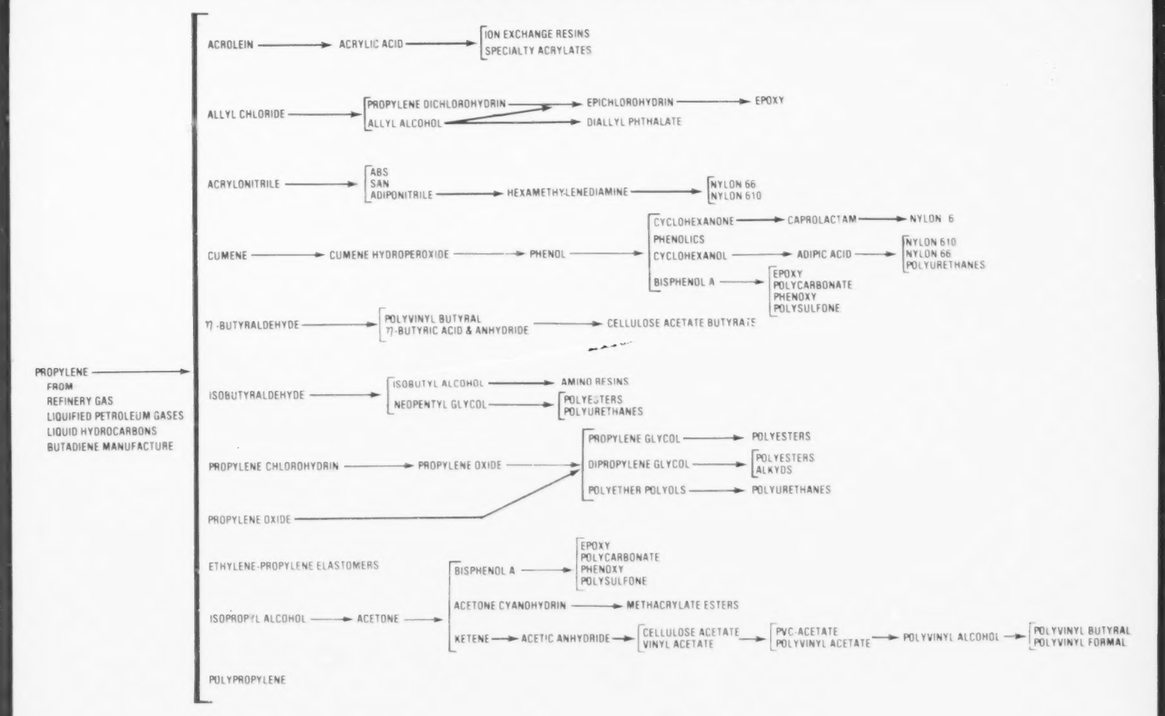
SAMPLE

Facts & Figures of the Plastics Industry

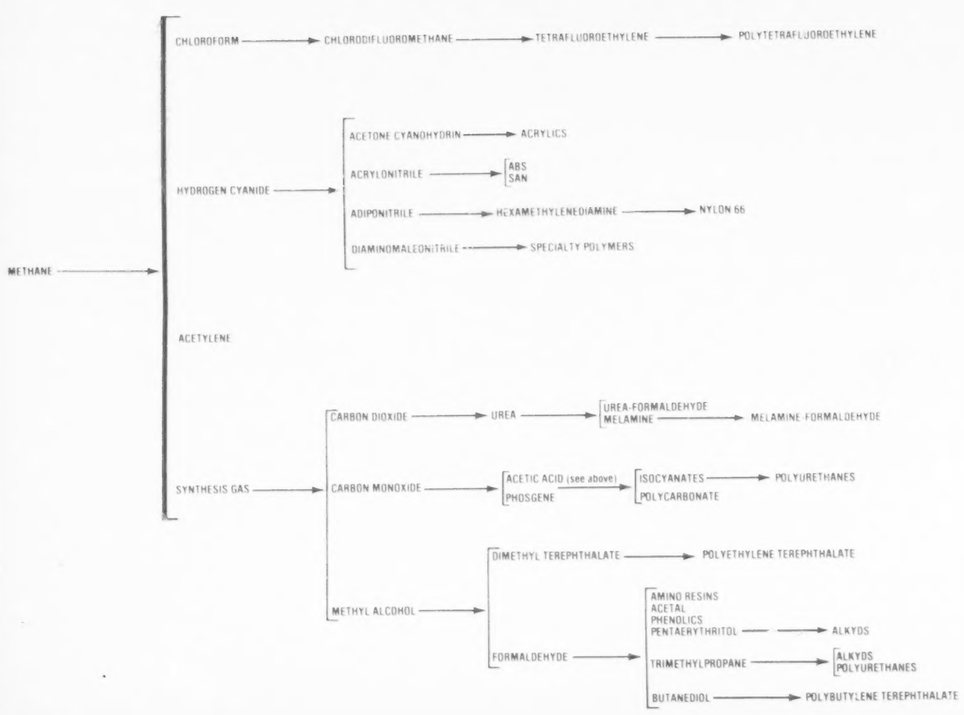
Plastics Derived from Ethylene



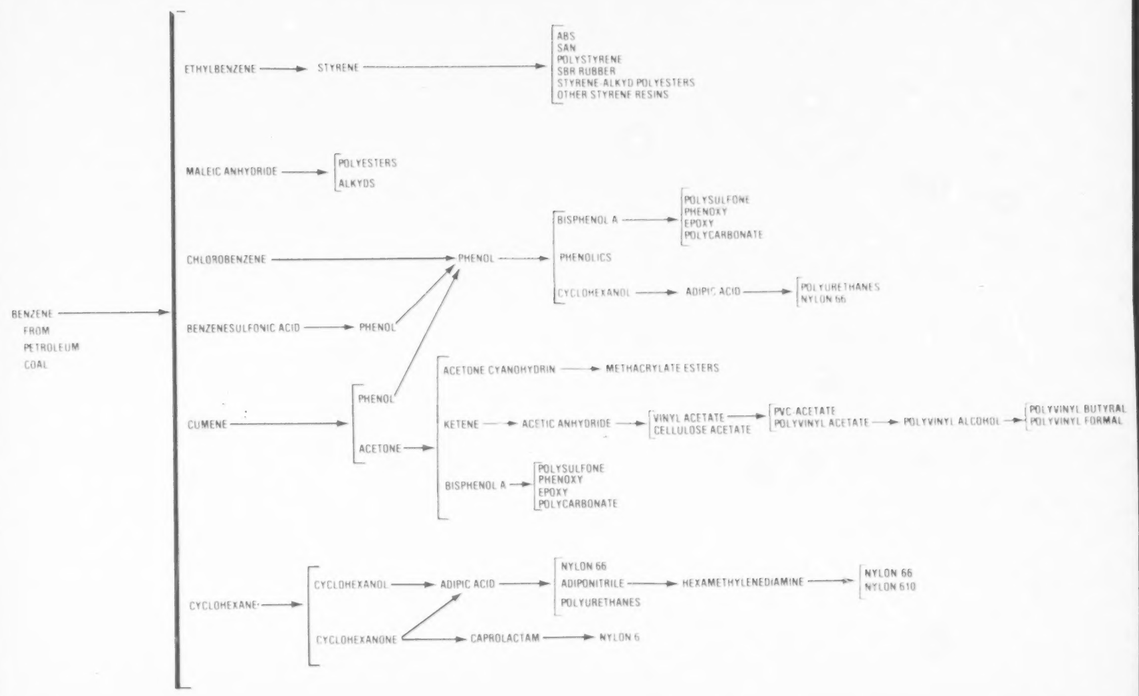
Plastics Derived from Propylene



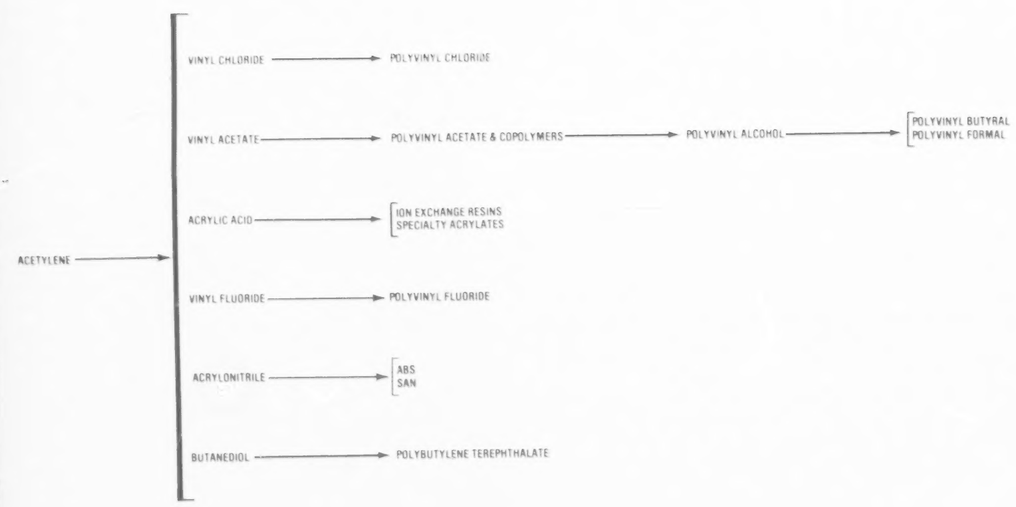
Plastics Derived from Methane



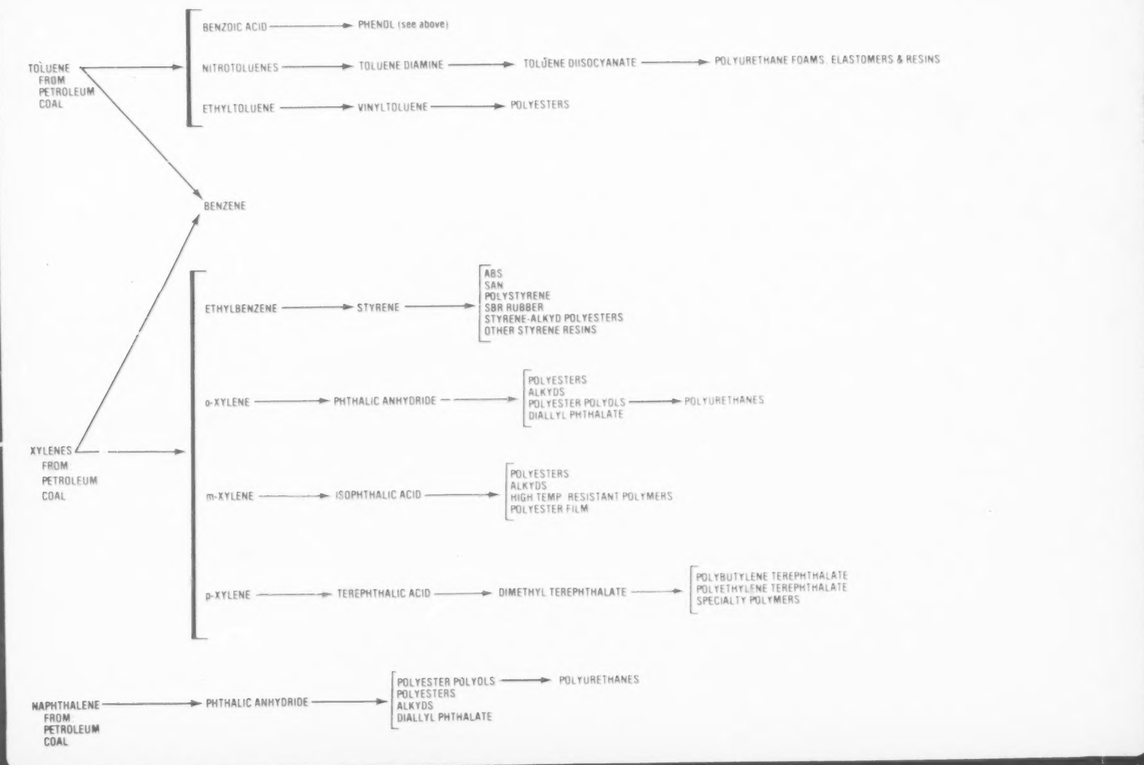
Plastics Derived from Benzene



Plastics Derived from Acetylene



Plastics Derived from Naphthalene, Toluene & Xylenes



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